USE OF A BANK-SIDE EXTRACTION WELL FIELD TEST TO INVESTIGATE HYPORHEIC ZONE NATURAL ATTENUATION

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Research concept and experimental design

Hyporheic zone

- **Mixing** of the ground and river waters
- Water **self purification** possible ⇒ may mitigate the impact of urban groundwater contaminant plumes
- Ratio of vertical to horizontal head gradients may affect exchanges

Objective

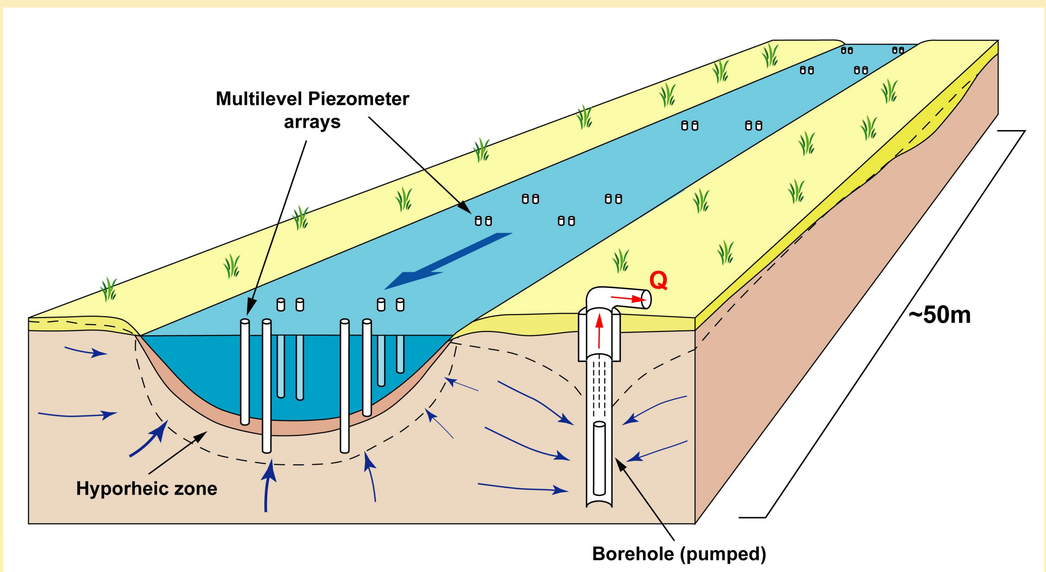
- Evaluate the **natural attenuation capacity** of the hyporheic zone under a **controlled flow regime**, given that the hydrodynamic conditions are assumed to influence those processes

Method: field test approach

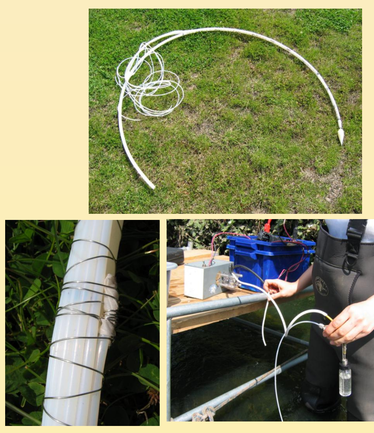
- Control the groundwater-surface water exchanges by **bank-side extraction well long-term field tests**
- Monitor the **transport of solutes/contaminants** and injected tracers
- Find out the **residence times across the hyporheic zone**, depending on the hydrodynamic conditions, different in each test

Pumping tests

- Well 5 m adjacent to the river, 15 m deep
- Manual and automatic monitoring of heads in the riverbed
- Short-term tests to find optimal conditions for long-term tests



Mini-drivepoint piezometers combined to multilevel samplers

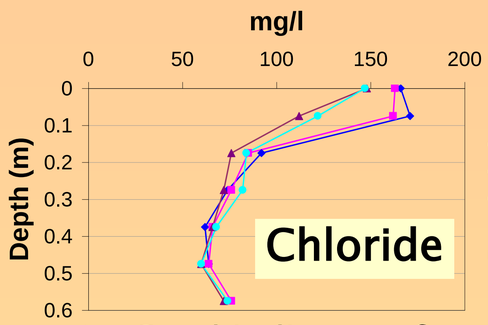


Test site:

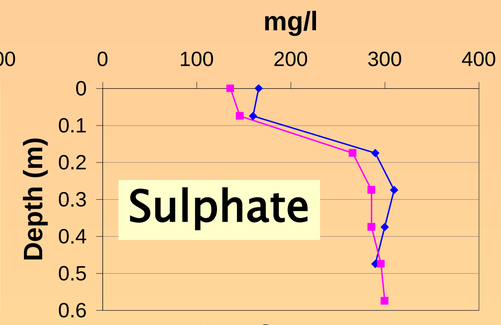
- urbanised reach of the River Tame, Birmingham (UK)
- Permo-Triassic Sandstone aquifer

Riverbed profiles further upstream on the River Tame

Chemical profiles

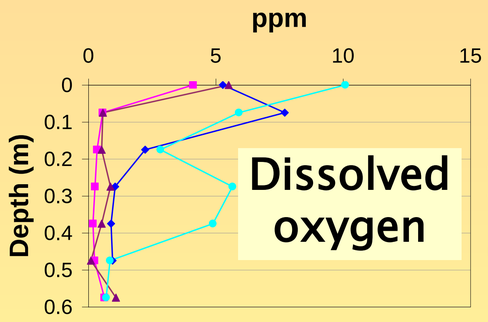


- Good indicator of groundwater-surface water mixing to 15-20cm below the riverbed



- Surface water dilution just below the riverbed

20/07/06
02/08/06
08/08/06
14/08/06

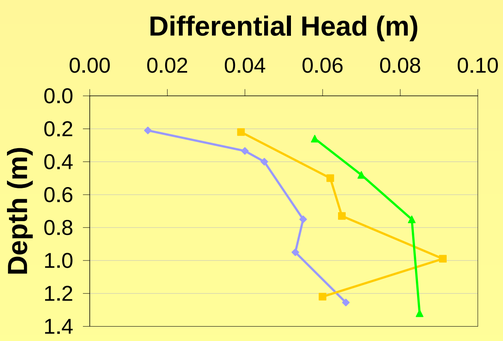


- Indicates complex temporal behaviour of this reactive solute

- Indicates dilution of groundwater nitrate and/or reaction

Hydrodynamical profiles

West side
Middle
East side



- Heads in the riverbed mostly above the river level → vertical flows towards the river

- Gradient increases at small depths

Preliminary simulations

Aims

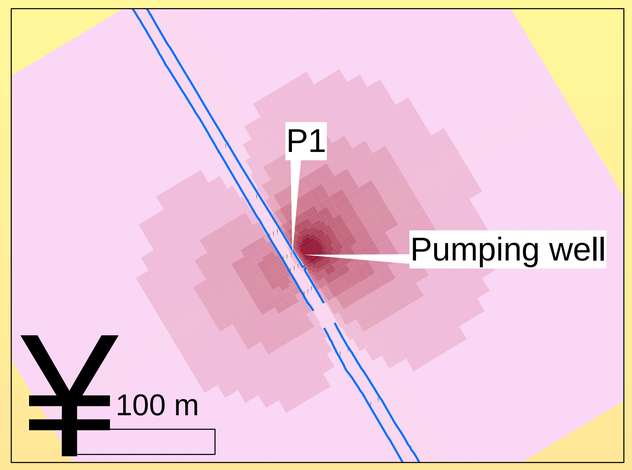
- First model applied to short-term extraction tests: helps to calibrate the **aquifer properties** based on head monitoring
- Pumping → change in measured and modelled gradients
- Preliminary simulations here, without any field data

Model geometry

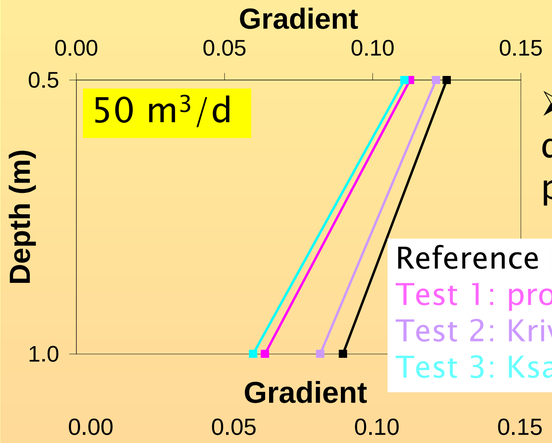
Hydraulic conductivities

- 3 principal geological layers
- 20 piezometers in the riverbed, 50cm or 1m deep

Drawdowns 1 m below ground level

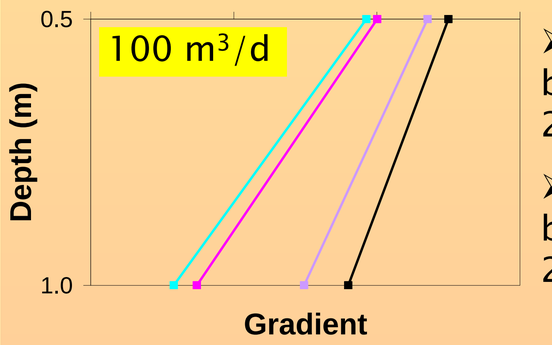


Sensitivity tests on P1

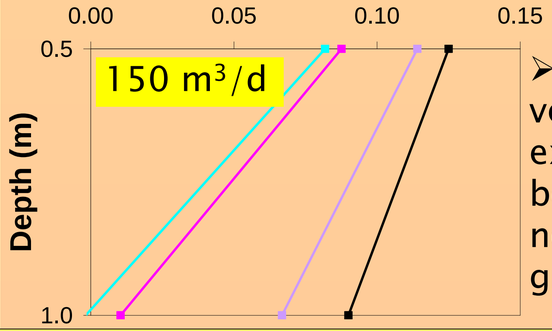


- Gradient decreased by pumping

Reference hypothesis
Test 1: properties above
Test 2: Kriverbed =20m/d
Test 3: Ksandstone = 1m/d



- K riverbed between 5 and 20 m/d
- K sandstone between 1 and 2 m/d



- At 150m³/d, vertical exchanges might be inversed: negative gradient in test 3

Future work

- Short-term extraction tests to determine the hydrodynamic properties and optimal pumping rates
- Long term extraction tests at various rates to establish the geochemical perturbation of the hyporheic zone

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