Dave Johnson
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The Rivers Trust
TOPSOIL: A Groundwater case study

• Groundwater & Climate Change
• Developing a shared understanding
• Doing something about it

Dave Johnson

the umbrella body of the rivers trust movement
where there’s water, there’s life
GW is the lowest carbon source of water

~£1M per ML per annum @ 2009 prices

<table>
<thead>
<tr>
<th>New supply option*</th>
<th>Emissions</th>
<th>Carbon cost relative to baseline</th>
<th>Carbon cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>kgCO₂/day/house</td>
<td>pence/m³</td>
<td>pence/m³</td>
<td></td>
</tr>
<tr>
<td>Current water 'supply-use-disposal' carbon cost</td>
<td>2.43</td>
<td>baseline</td>
<td>28</td>
</tr>
<tr>
<td>Direct ground water abstraction</td>
<td>2.46</td>
<td>+1</td>
<td>29</td>
</tr>
<tr>
<td>Aquifer storage and recharge</td>
<td>2.47</td>
<td>+1</td>
<td>29</td>
</tr>
<tr>
<td>River intake</td>
<td>2.48</td>
<td>+2</td>
<td>30</td>
</tr>
<tr>
<td>Indirect effluent reuse</td>
<td>2.57</td>
<td>+3</td>
<td>31</td>
</tr>
<tr>
<td>Reservoir</td>
<td>2.61</td>
<td>+3</td>
<td>31</td>
</tr>
<tr>
<td>Desalination (brackish water)</td>
<td>2.91</td>
<td>+6</td>
<td>34</td>
</tr>
<tr>
<td>Desalination (saline water)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Option</th>
<th>Range of costs (pence per cubic metre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near-universal (90%) metering⁵⁸</td>
<td>140-160</td>
</tr>
<tr>
<td>Groundwater development</td>
<td>100-500</td>
</tr>
<tr>
<td>Surface water development</td>
<td>100-500</td>
</tr>
<tr>
<td>New reservoir</td>
<td>300-1000</td>
</tr>
<tr>
<td>Desalination plant</td>
<td>400-800</td>
</tr>
</tbody>
</table>
How the GW abstraction works?

Aim: To get a shared understanding of how the system works. Start with CaBA data package and add in local data.....
How the GW system works

XXX Group BHs

15Ml/d (license)
15,000 M³/d
3.3 M Gallons/d
5.3Ml/d (Actual)

XXX Group BHs

7Ml/d (license)
7,000 M³/d
1.5 M Gallons/d
4 to 5 Ml/d
(Actual)

Towns:
- Town 1
- Town 2
- Town 3
- Town 4
- Town 5
- Town 6

CO2

Brine to STW

81,500 people

Around £5M per annum @ 2009 prices

@ 2009 prices
How the natural Groundwater system works: Recharge and groundwater flow
How does the system change if we abstract water?
How does the system change if we abstract water?
Nitrate concentration in groundwater
Welcome to the WFDVisual search tool. To start a search, please select from the options below. This screen lists the search options for the different water body settings. At present, only groundwater is represented.

For the groundwater option there are currently three landscape/land use settings: rural lowland, rural upland and urban lowland.

To run a search:
1) Select your desired landscape/land use scenario.
2) Choose the search type - specific, rule-based search, or broad search.
3) The search options are listed in groups according to whether they are pollution or abstraction pressures, pathway factors or receptors (i.e., the Source-Pathway-Receptor model). There are additional options to choose from also, to enhance the image.
4) Specify which options you want in your search by changing the order of the traffic lights.
5) When you are happy with your options, select ‘Run This Search’ from the bottom of the page.

Water bodies:
- Groundwater
- Wetlands
- Rivers
- Coastal
- Transitional Waters

Can’t find what you are looking for? Don’t forget to have a look at the storyboard images, or contact us to let us know what other images would be useful for you.

Scenario:
- Rural Lowland
- Rural Upland
- Urban Lowland
How the natural Groundwater system works: Recharge and groundwater flow
How the natural Groundwater system works: Recharge and groundwater flow
Crop type. Some crops leak more nitrate, not just down to application rates

[Bar chart showing nitrate levels for different crops, with a red dotted line indicating a threshold.]

What if practice has changed?
Some manures leach more than others

![Graph showing the leaching of N as a percentage of total applied for slurry/poultry manure and farmyard manure over the months of Sept to Jan. The graph indicates that Sept and Oct have the highest leaching rates, while Jan has the lowest.](image-url)
Early autumn planting, including cover crops significantly reduces leaching.

![Graph showing N loss kg/ha from 1990 to 1994 for Winter Cereal and Cover crop.](image)

**Local trials?**
Low-optimal N?: Profit vs. application

Pers
comm
DTC

Difference in N supply from optimum (kg/ha)
*based on wheat = £100/t; ammonium nitrate = £173/t
Hierarchy of asks: Water company

1. **Landuse.** Woodland => permanent pasture => low leaching crops => high leaching crops => plough-up

2. **Manure management.** Minimal manure in GW catchment => No autumn application => Low N manure => slurry or poultry litter & outdoor pigs.

3. **Autumn cover.** Early autumn establishment => Cover crops => ‘greening up’ => late harvest & bare soil.

4. **Nutrient application.** Low-optimal nutrient application => Precision nutrient management => full evaluation of manures => Insurance application for yield or quality.

2) Local trials
Balancing the asks: Water company & farmer

- Overwinter stubble
- Main crop potatoes
- Maize

- Autumn cover: No overwinter bare soil
- More water for irrigation

- Transfer SW licence
- Independent advice
- Stage 2: trade offs

The water company
The farmer
Early autumn planting, including cover crops significantly reduces leaching.