Steve Fletcher
National Groundwater & Contaminated Land Centre
Summary

- Nature of the Directive
- What is an aquifer?
- Quantitative status
- What’s gone wrong?
- Groundwater bodies
Purpose of the Water Framework Directive

• ... purpose... is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters, and groundwater which:
  • protects and enhances...aquatic ecosystems...with regard to their water needs...terrestrial ecosystems and wetlands ...
  • enhanced protection of the aquatic environment ...
    ...reduction of discharges ...hazardous substances
  • promotes sustainable water use...
  • ensures progressive reduction of pollution of groundwater...
  • mitigates effects of floods and droughts...
Whereases 34 of 53

For the purposes of environmental protection there is a need for greater integration of the qualitative and quantitative aspects of both surface waters and groundwaters

Note!
Whereases 25

Common definitions of status of water in terms of quality and where relevant for the purpose of environmental protection, quantity should be established.
Whereas 19

...control of quantity is an ancillary element in securing good water quality and therefore measures on quantity, serving the objective of ensuring good water quality, should also be established.
Whereases 20

... quantitative status of a body of groundwater may have an important impact on the ecological quality of surface waters and terrestrial ecosystems associated with that groundwater
Whereases 40

For water quantity, overall principles should be laid down for control on abstraction and impoundment in order to ensure the environmental sustainability of the affected water systems.
Quantity Rules OK
Triptych 1

• “Groundwater” means all water that is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil.
Surface Water

“inland waters except groundwater”

- What is recharge in the unsaturated zone?
- What is perched groundwater?
“Aquifer” means a subsurface layer or layers of rock or other geological strata of sufficient porosity and permeability to allow either a significant flow of groundwater or the abstraction of significant quantities of groundwater.
What is significant?

One

A significant flow is one which, were it to be removed would prevent the achievement of the objectives of Article 4 for the associated surface water or terrestrial ecosystem

SWF
Whereas 37

The late arrival at the ball

MS should identify waters used for abstraction of drinking water and ensure compliance with the DWD 1980
Drinking Water

Article 7 requires the identification of:

- all bodies of water used for abstraction of water intended for human consumption providing more than 10m³/d on average or serving more than 50 persons.
- those bodies of water intended for such future use
- Where does this come from?
Member states may exempt from the provisions:

...water intended for human consumption from an individual supply providing less than 10m3/d as an average or serving less than 50 persons ...
Member states shall monitor, in accordance with Annex 5, those bodies of water which according to Annex 5, provide more than 100 m$^3$/d as an average.
What is significant?

Two

• all rocks which supply >10m3/d on average are therefore aquifers and therefore have to be characterised as groundwater bodies – the UK?

• Ignore?

• Discuss!
• “Body of groundwater” means a distinct volume of groundwater within an aquifer or aquifers.
Groundwater Bodies

- Characterise
- Further Characterise if at risk
- Programme of measures if at risk
- Manage

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Development Cycle for Conceptual models

Best Conceptual Model

Better Conceptual Model

First Conceptual Model

Initial ideas

Process

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Development Cycle for Conceptual models

Best Conceptual Model

Better Conceptual Model

First Conceptual Model

Initial ideas

How far do you have to go

Best
Basic

Basic

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Initial Characterisation

**Identify**

- Diffuse Pollution
- Point source pollution
- Artificial recharge
- Abstraction

**Assess**

- Location of boundaries
- Pressures
- Character of overlying strata
- Identify those GW bodies for which there are dependant surface water or terrestrial ecosystems
- Test whether Groundwater Body will meet the objectives of Article 4

Next drawing
What is in Article 4

- Protect enhance & restore all GW Bodies
- Ensure a balance between abstraction and recharge of groundwater
- Be able to achieve good groundwater status within 15 years

Next drawing
Definitions

• “Groundwater Status” is the general expression of the status of a body of groundwater determined by the poorer of its quantitative status and its chemical status.
Definitions

- “Quantitative Status” is an expression of the degree to which a body of groundwater is affected by direct and indirect abstractions.
Definitions

- “Good quantitative status” is the status defined in table 2.1.2 of Annex V
Whereases 28

SW & GW are in principle renewable natural resources....

...in particular...the task of ensuring good status of groundwater requires early action...

... natural time lag in its formation(*sic*) and renewal
Achieving Good Status

Be able to achieve good status

(Level is such that)
Long term annual average rate of abstraction < available groundwater resource

Available Resource

Will not cause saltwater or other intrusion

No significant damage to associated terrestrial ecosystems which depend directly on the GW Body

No significant diminution in status of these waters

Will not fail to achieve environmental objectives in associated surface waters
Available Groundwater Resource

Long term annual average rate of overall recharge

Long term annual average rate of flow required to achieve the ecological quality objectives for the associated surface water bodies
Quantitative Status

- Level *cannot* indicate quantitative status unless you have long runs of data.
- Level can only indicate a decrease in status *after* it has happened and after ecological damage has occurred.
- Against the spirit of the Directive.
Groundwater Monitoring Network

Designed so as to provide a reliable assessment of the quantitative status ... including assessment of available groundwater resource

which is:-

• the long term annual average rate of overall recharge

• the long term annual rate of flow required to achieve the ecological quality objectives for associated surface waters
Further Characterisation

Geological and Hydrogeological characteristics
- K, porosity, confining layers
- Stratification characteristics of the groundwater

Characteristics of the superficial deposits & soils

Inventory of dynamically linked SW systems & terrestrial ecosystems
- Estimates of the rates of exchange between SW & GW

Characterisation of the chemical composition of the GW body

Impact of human activity

Data to calculate long term annual rate of recharge
Defining Groundwater Bodies

Figure 1
Using Geological Boundaries

- Groundwater Flow Line
- Impermeable Geological Fault
- Contours
- Groundwater Bodies
Defining Groundwater Bodies

Figure 2
Groundwater Flow Lines

- Green arrow: Groundwater Flow Line
- Red line: Impermeable Geological Fault
- Blue line: Contours
- Black dotted line: Groundwater Bodies

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Defining Groundwater Bodies

Figure 3
Subsidiary Flow Line Boundary

- Green line: Groundwater Flow Line
- Red line: Impermeable Geological Fault
- Blue line: Contours
- Dashed line: Groundwater Bodies

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Defining Groundwater Bodies

Figure 4
Subsidiary Flow Line Boundary Along Groundwater “ridge”

- Green line: Groundwater Flow Line
- Red line: Impermeable Geological Fault
- Blue line: Contours
- Dotted line: Groundwater Bodies

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The End