British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Groundwater Bodies in the UK

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2nd Workshop on Groundwater Bodies in Europe

Introduction

- Background
- Delineation in UK – England, Wales, Scotland, NI
- Implementation process
- Future developments – 2nd cycle

Background (CIS criteria)

- Management Units to support practical implementation of WFD/GWD.
- GWBs must enable:
  - WFD/GWB objectives to be achieved (status, trends, prevent or limit and PoMs)
  - Required characterisation, assessment and reporting
- GWBs are three-dimensional hydrogeological units and size may vary (all dimensions)
- Grouping and/or sub-division should be considered to enable better management
- GWB boundaries can be revised on basis of better data and experience of use

UK Procedure – Step 1

- Define ‘aquifer types’
  - Develop aquifer type maps based on geology, GWV etc
  - Identification of ‘non aquifers’/‘unproductive strata’

- Plus: compilation of supporting data:
  - Surface water bodies/drainage networks
  - Catchment boundaries
  - Identification of key receptors – GWDTE, salinity boundaries, abstractions etc
  - Chemical and quantitative pressures

Step 2

- Sub-divide aquifers into manageable units
  - Geological boundaries and/or
  - Groundwater divides (or SW catchment boundaries where appropriate)
  - Regional flow lines (groundwater catchments) and/or
  - Other no-flow boundaries (regional GW models)
- Key factors to consider:
  - Must enable calculation of water balance (for quantitative status assessment)
  - Scale important – identification of pressures v management
  - Recognition of 3D nature but also limitations of map representation (attribution of boreholes)
  - Upper and lower boundaries
  - Adjacent aquifers and layered aquifers

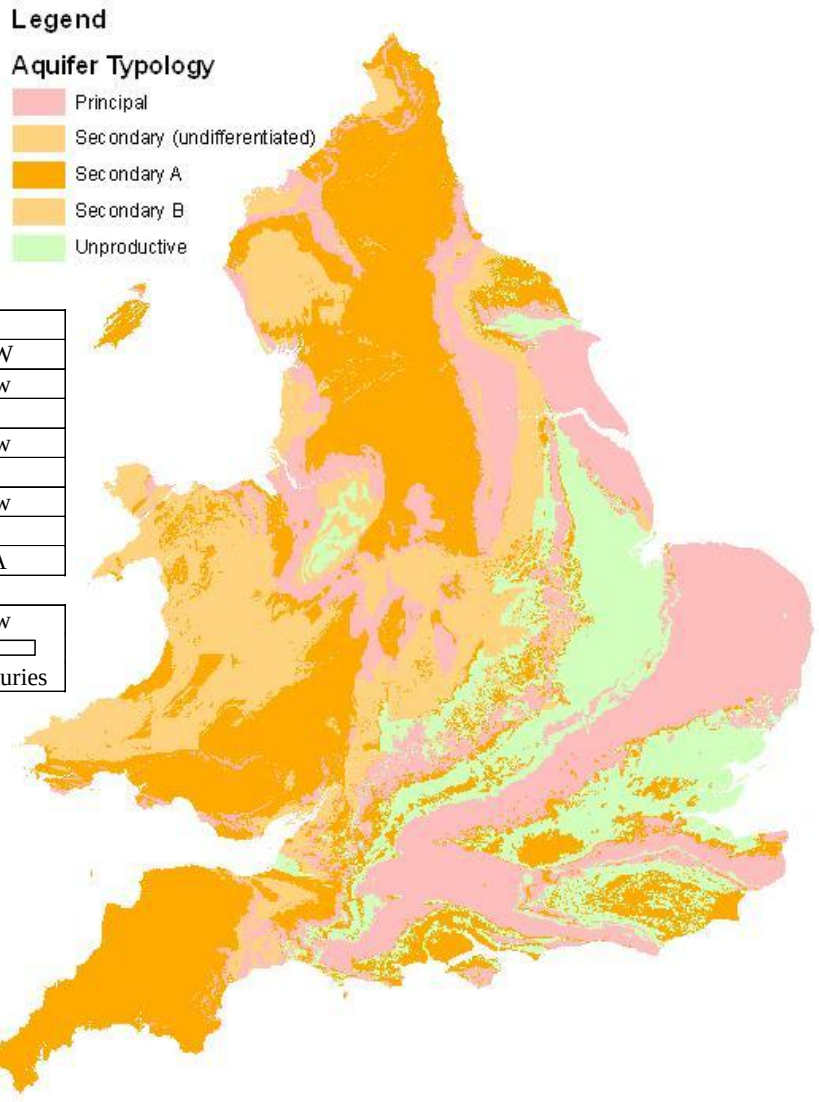
Step 3

- Further sub-division/amalgamation based on pressures, but:
  - Same rules of delineation must apply to enable consistency in approach
  - Must be done in combination with risk assessment process
- Regular review of groundwater body boundaries at key stages – river basin cycle and key milestones – RA update, classification etc

England and Wales – RBC1

- 2004 – 356 GWBs delineated by applying UK and CIS guidance (reported to EC in 2005)
- Main criteria used:
  - BGS 250K bedrock geology and CAMS surface water boundaries (reference to 50K geology in some locations)
  - RBD boundaries
  - Minimum size – 50km^2 (except islands)
- GIS approach used with some (limited) consultation with regional/local experts.
- 2006 – review of GWBs ahead of classification
  - Better data: RA outputs, improved CAMS, familiarisation/feedback
  - Superficial deposits considered where over UPS
  - Reduced to 304 GWBs

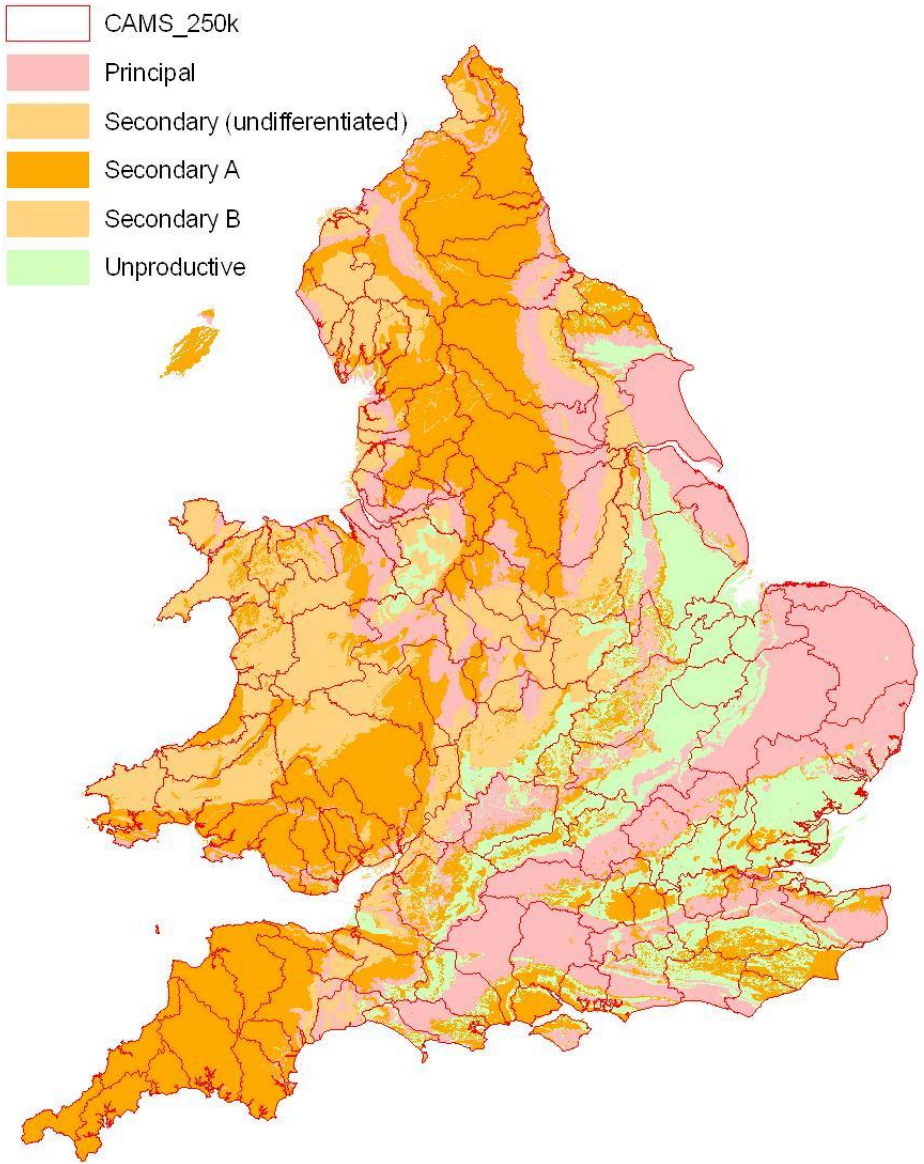
Process (E&W)

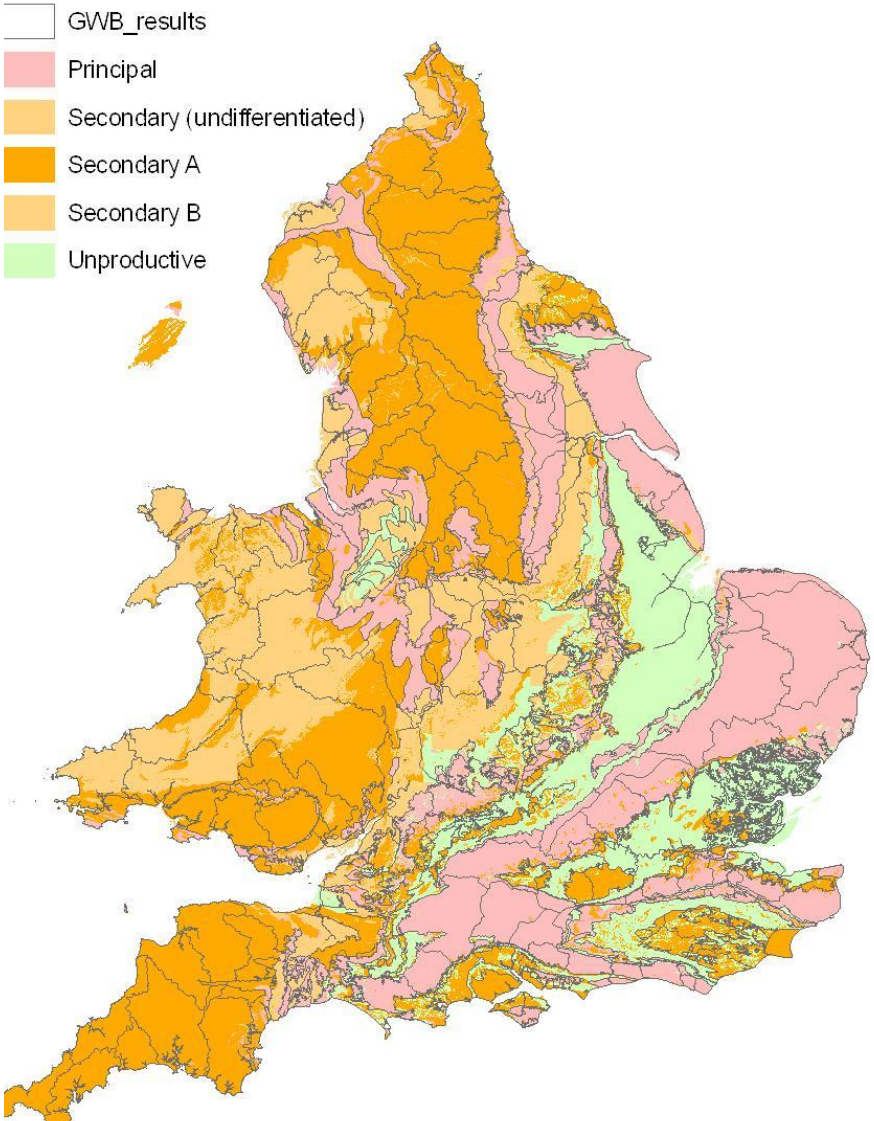


			TRANSMISSIVITY		
No	DOMINANT FLOW MECHANISM		HIGH	MEDIUM	LOW
1	**Intergranular**/Dual porosity		Fast	Moderate	Slow
2	**Fracture**/Dual porosity		Fast		
3a	Multi-layered	Integranular	Fast	Moderate	Slow
3b		Fracture	Fast		
4a	Non Aquifer with	Integranular	Fast	Moderate	Slow
4b	productive horizons	Fracture	Fast		
5	Non Aquifer		N/A	N/A	N/A

Fast		Moderate		Slow
Days	Months	Years	Decades	Centuries

Next steps


CAMS_250k
Principal
Secondary (undifferentiated)
Secondary A
Secondary B
Unproductive


GWB_results
Principal
Secondary (undifferentiated)
Secondary A
Secondary B
Unproductive

Scotland and N. Ireland

- E&W – Environment Agency (EA)
- Scotland – SEPA
- NI – NI Environment Agency (NIEA)
- Followed UKTAG/CIS rules as far as possible. Did not have CAMS equivalent or same data sources. Common element was BGS geology.
- Geology – hydrogeological properties – aquifer type map – sub-division (catchments)
- Ireland – transboundary GWBs

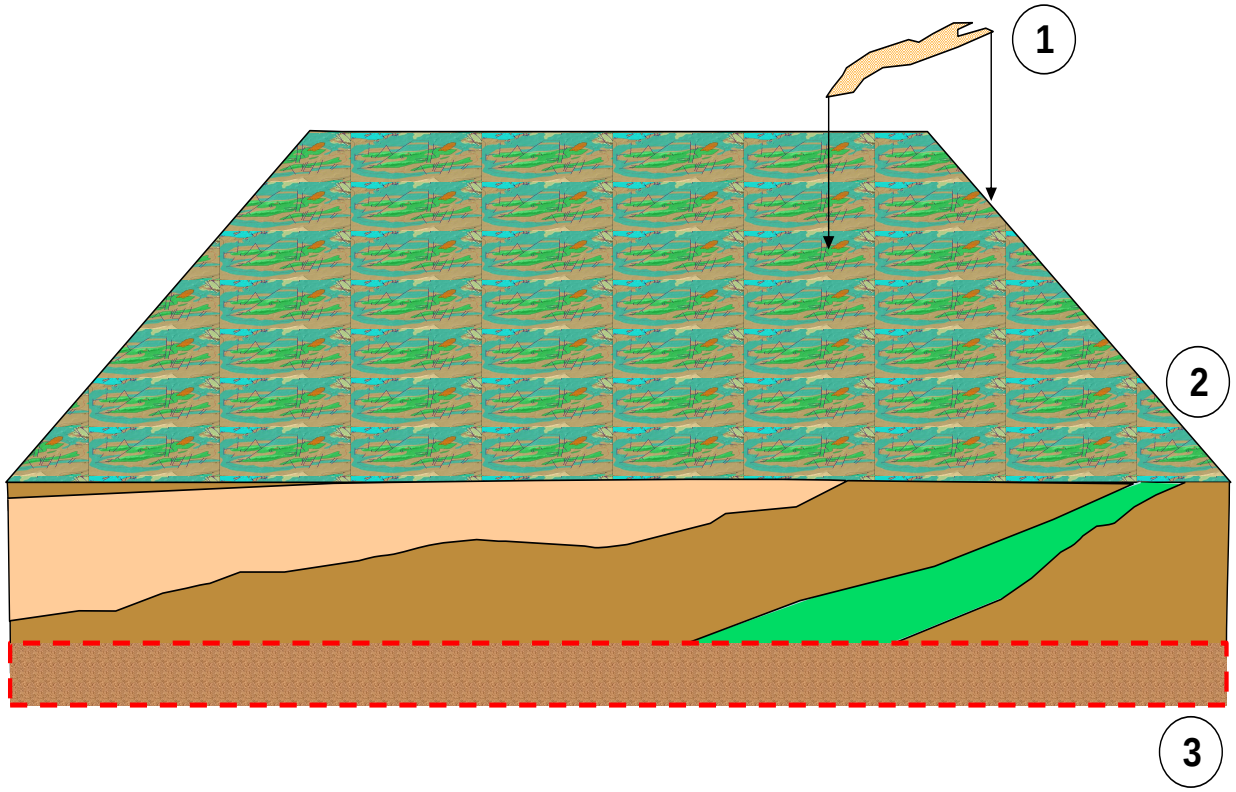
2011 GWB Review

- Next generation GWBs for 2nd RBC
- Collect feedback from RBC1 and address EC requirements for reporting etc
- Use improved data – better geology (50K)
- Take into account changes to SW bodies
- Improvements in 3D characterisation
- Alignment of GW datasets, management units - future proof

Default GWB thicknesses

UK and Ireland Generic types of aquifer	UK and Ireland examples	Formation Type - EU CIS criteria	Depth of main part of the GWB* - CIS criteria	Default Max. Depth Below Ground*
Porous superficial	Sand & Gravel	Porous aquifer – highly productive	0-20 m	40 m
Dominantly porous bedrock	Sherwood Sandstone	Porous aquifer – highly productive	50-200 m	400 m
Dual porosity high transmissivity	Chalk	Porous aquifer – highly productive	50-200 m	400 m
Moderate transmissivity bedrock	Carboniferous sandstones	Fissured aquifer – moderately productive	50-200 m	400 m
Low transmissivity bedrock	Dalradian	Insignificant aquifers – local and limited groundwater	20-50 m	100 m
Karst	Carboniferous limestones	Fissured aquifer – highly productive	50-200 m	400 m

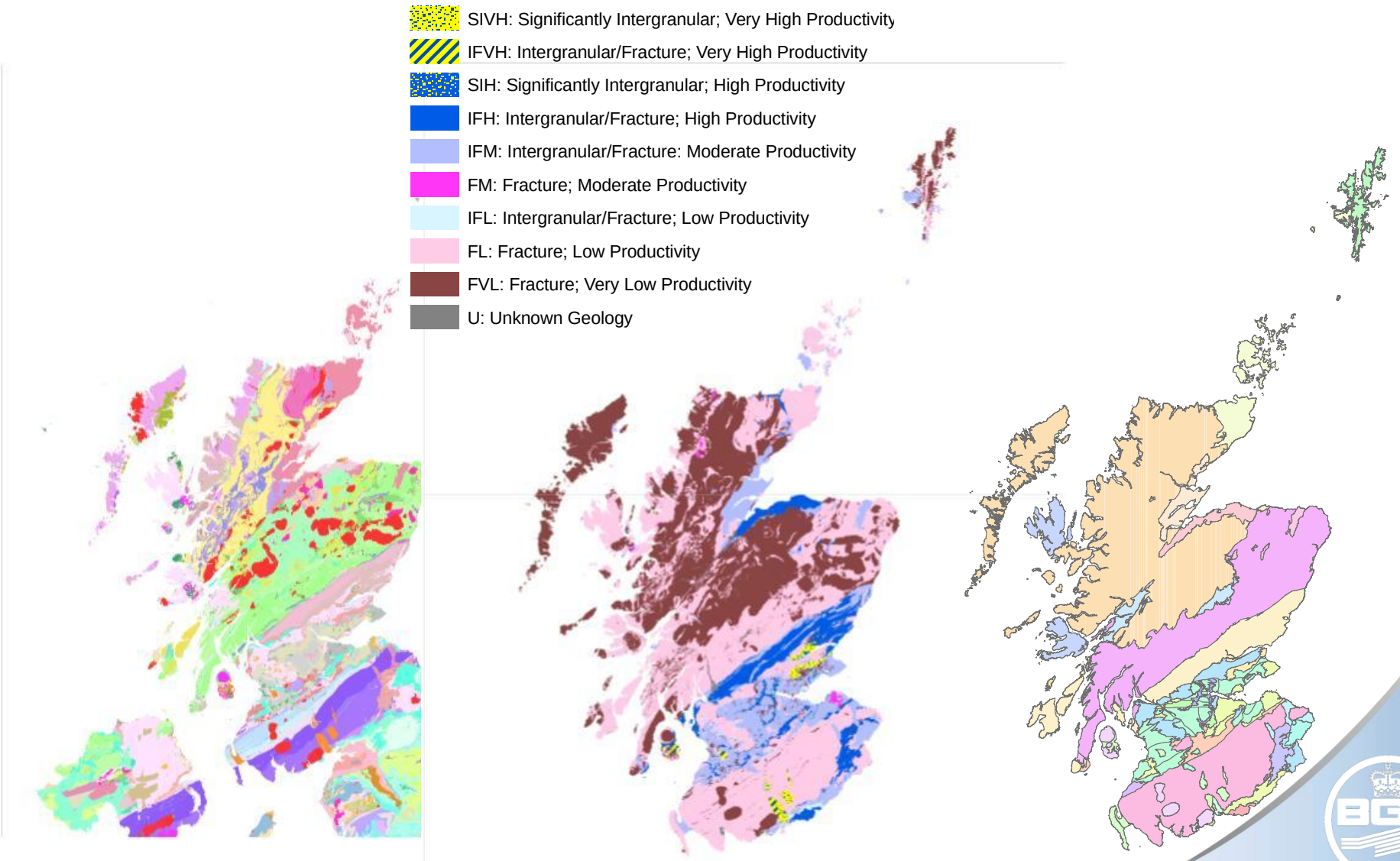
GWB conceptualisation



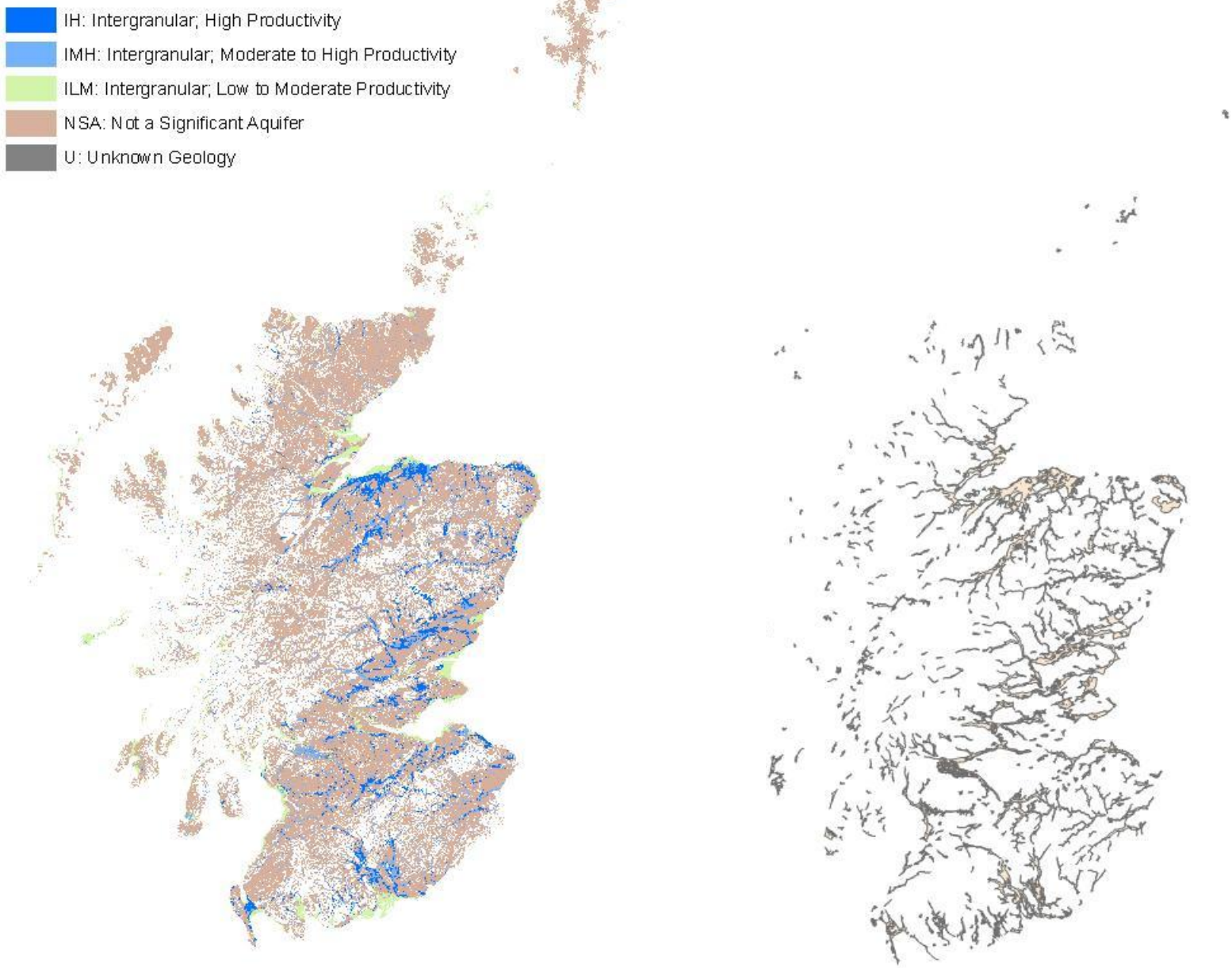
Legend

- Productive Fissured bedrock GWB
- Karstified bedrock GWB
- Poorly Productive bedrock GWB
- Effective extent of confined GWB
- Sand & Gravel GWB
- syncline axis
- fault
- thrust zone
- 1 Horizon in GIS

GWB Scotland (bedrock)



GWB Scotland (superficial)



Summary

- GWBs in UK are practical management units based on CIS guidance – hydrogeological
- GWB currently being reviewed and updated based on improved data and feedback from RBC1
- Greater consideration being given to third dimension but remains challenging
- Outcome must be ‘fit for purpose’ and lead to better management
- Greater consistency with other GW and geology datasets

Further information

- www.wfduk.org
  - UK (and ROI) guidance on WFD implementation

Scotland/NI rules

- GWB for both bedrock and superficial material – based on DigMap-50
- To be subsequently subdivided by SEPA using catchment and pressures criteria.
- **Superficials approach**
- Used BGS productivity map – simplified (size exclusion, narrow strips)
- Low permeability material was removed from map
- Moderate and high used
- Polygons removed with areas <1 km^2
- Polygons between 0.5 and 1 km^2 which lie closer than 100 m from larger polygons added back in:
- Stringer < 25 m width removed
- Deposits < 3 m thick were removed
- The resulting data are taken to represent significant superficial aquifer deposits which have areas generally in excess of 1 km^2.

- **Midland Valley**
-
- Coalfields divided as follows:
- Areas subdivided by main faults, particularly where SEPA groundwater level information suggests hydraulic separation.
- Futher structural information (e.g. anticlines) used to subdivide central and Fife Coalfields
- Dykes used to subdivide Central Coalfield area.
- **Main Bedrock bodies**
- Boundaries taken where productivity changes. Inliers and outliers occur these were incorporated into the surrounding groundwater body, unless they were deemed large and hydraulically significant enough to form a separate body.

Clarification of definitions

Zone	Role	Terminology
Water in unsaturated zone	Pore water above the water table. Protect as a vertical pathway to groundwater.	Pore water
Water in saturation zone	Pore water in low permeability deposits. The concept of the zone of saturation is not relevant in these deposits as it is usually not feasible to define a water table where lateral percolation is impeded. The main role of these strata is as a protecting layer for groundwater.	
	Groundwater has a value as a lateral or vertical pathway to other receptors. May be usable, but only for local supplies <10m^3/day.	Groundwater in strata overlying or underlying groundwater bodies
	Groundwater is part of an aquifer and is a receptor as a long term resource that can be exploited for human activities or support surface flows & ecosystems.	Groundwater in a groundwater body
	Groundwater which has neither pathway nor resource value. For example, where salinity is greater than seawater.	Groundwater that is Permanently unsuitable for use