

# Groundwater Mapping and Management in England

David Banks

Consultant hydrogeologist, NORPLAN  
Director of Holymoore Consultancy Ltd.

**NORPLAN**   
Consulting Engineers and Planners

**HolyMoore**  




**SEDIMENTARY ROCKS**

**Cenozoic**

Palaeogene, Neogene, Pliocene and Quaternary

**Mesozoic**

Cretaceous

Jurassic

Triassic

**Palaeozoic**

Permian

Carboniferous

Devonian

Silurian

Ordovician

Cambrian

**Upper Proterozoic**

Neoproterozoic

**METAMORPHIC ROCKS**

Lower Palaeozoic and Upper Proterozoic

Lower Proterozoic and Archaean

**IGNEOUS ROCKS**

Intrusive

Volcanic

Coast

Land/Sea

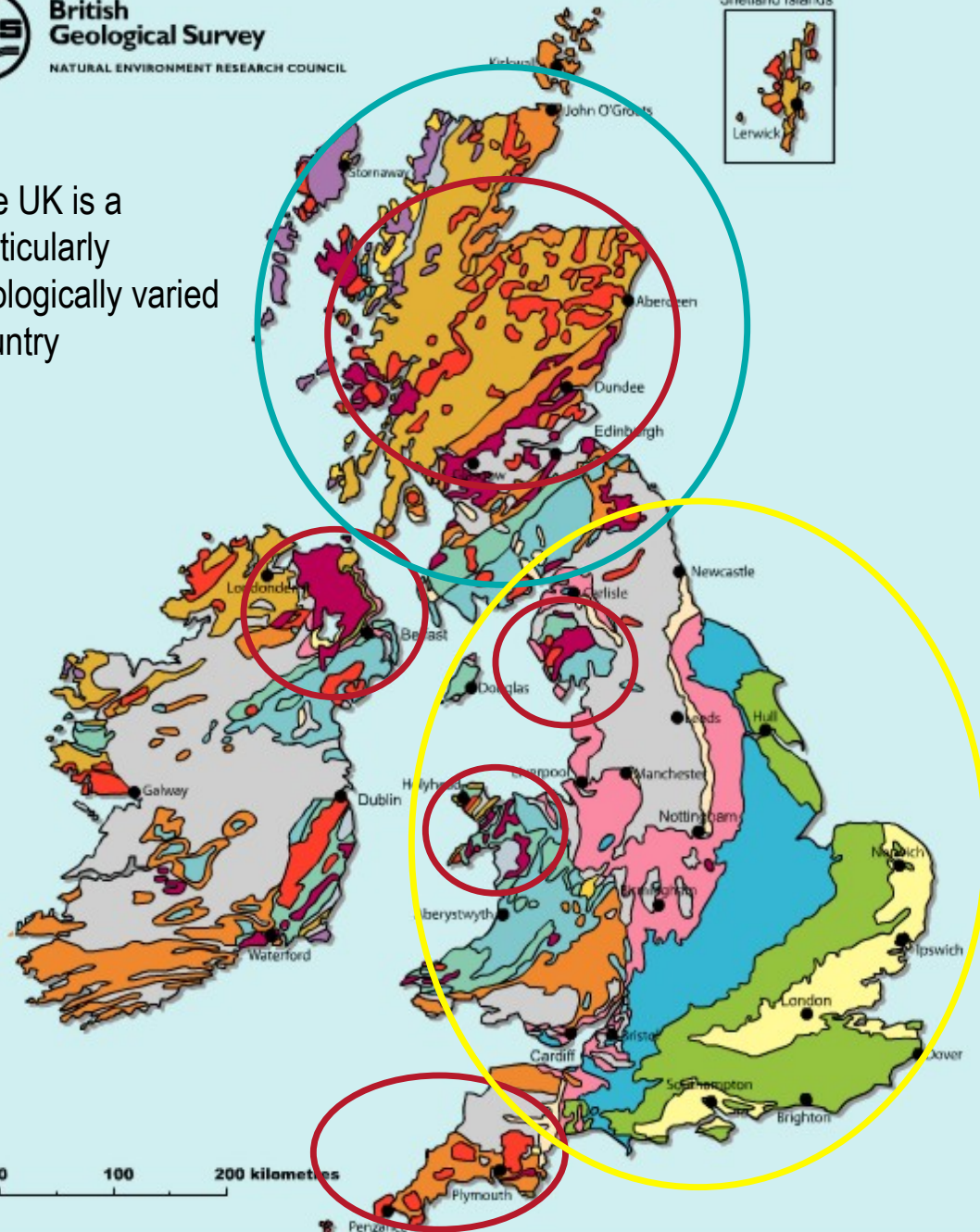
Linework

Locations

Exit

From the © British Geological Survey's "Make a Map" website: <http://www.bgs.ac.uk/education/makeamap/>

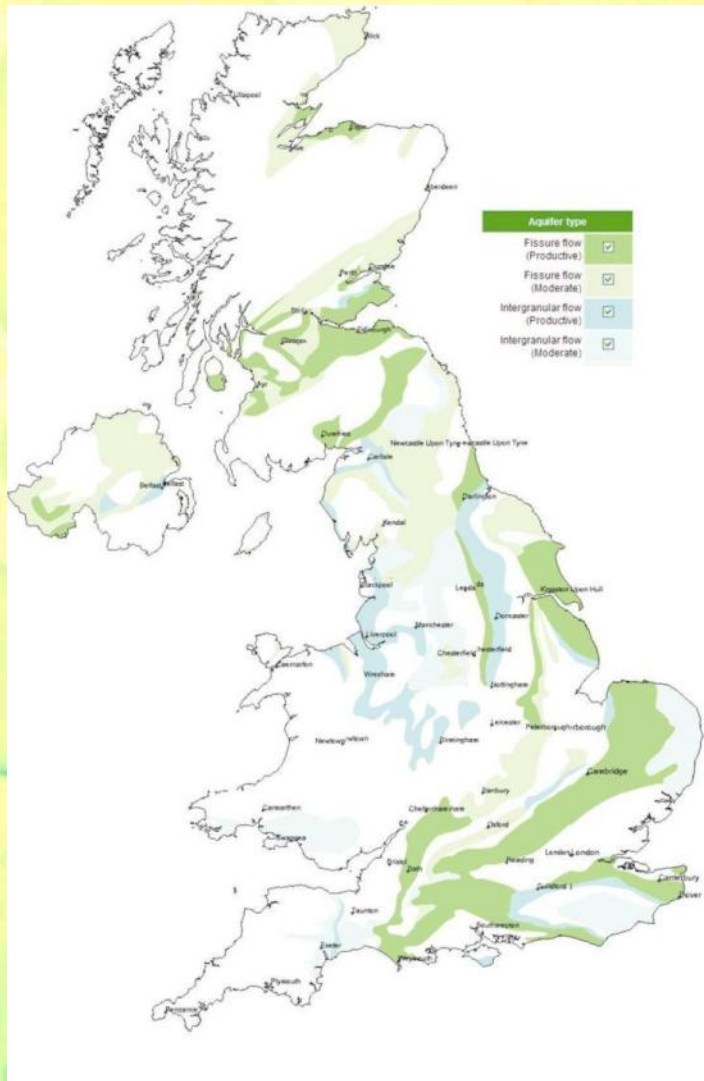
0 100 200 kilometres



## Main aquifers

Green = fractured

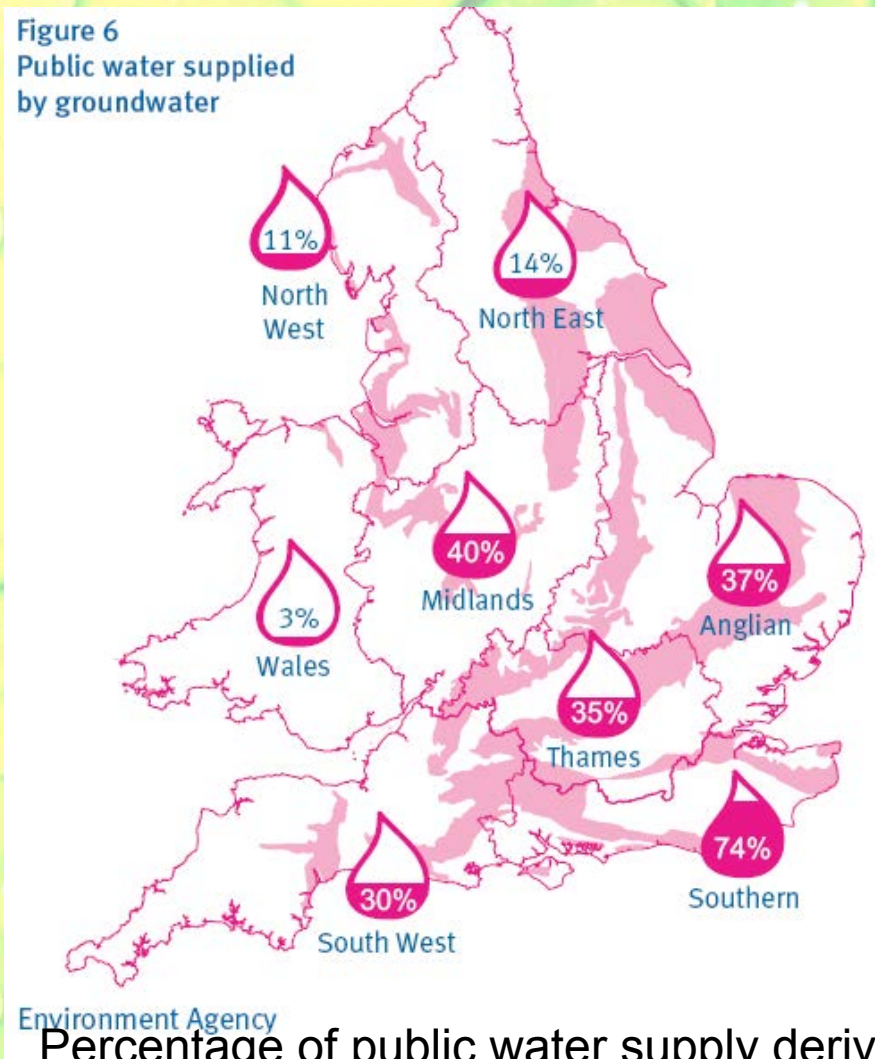
Blue = granular



From the © British Geological Survey's "Britain Beneath our Feet"  
website: [http://www.bgs.ac.uk/britainbeneath/land\\_hydrogeology.html](http://www.bgs.ac.uk/britainbeneath/land_hydrogeology.html)

## Hydrogeology

Figure 6  
Public water supplied  
by groundwater



Percentage of public water supply derived  
from groundwater

From: Environment Agency (2006) "Underground, under threat. The state of groundwater in England and Wales"



# Water Management

Hydrogeological mapping is carried out by the **British Geological Survey**, partly funded by the **Natural Environment Research Council (NERC)**



Water is managed and monitored on the basis of river catchments by the **Environment Agency** (executive non-departmental public body, sponsored by the **Department for Environment, Food & Rural Affairs**).



Public water supply is largely provided by **private water utility companies**, regulated by **OFWAT**





# British Geological Survey has adopted an Open Geology policy (online map databases such as GeoIndex)

GeoIndex - British Geological Survey - Mozilla Firefox

mapapps2.bgs.ac.uk/geoindex/home.html

**GEOINDEX ONSHORE**

Enter location

**Data**

- Linear features 1:50,000 scale
- Bedrock geology 1:50,000 scale
- Superficial deposits

**Available Layers** Filter by: Topic (All)

- Artificial ground 1:50,000 scale
- Superficial deposits 1:50,000 scale
- Bedrock geology 1:50,000 scale
- Faults 1:625,000 scale
- Dykes 1:625,000 scale
- Superficial deposits 1:625,000 scale
- Bedrock geology 1:625,000 scale

**Boreholes**

- Borehole scans
- Opencast coal prospecting sites
- Water wells
- Site investigation reports
- Drillcore
- Samples
- Onshore hydrocarbon wells

**Technical reports**

**Photos**

- Geoscenic Photos

**Hydrogeology**

- Hydrogeology 1:625,000 scale

**Minerals**

- Mineral Planning Authorities
- Mineral Occurrences
- Mineral Planning Permissions
- Mineral Planning Permissions (Points)
- Opencast Coal (worked area) 2006
- Active mines and quarries
- Historic Slate Quarries (Wales)
- Historic Building Stone Quarries (Wales & Scotland)

Click to add/remove map layers

Location: 449636, 380448

Ordnance Survey data © Crown copyright and database right 2014

10:31 28/05/2015



1" N.S. 100  
1" O.S.  
Grid SH 38 SW/1  
Ref.

\_\_\_\_\_ in parish of \_\_\_\_\_ Map very difficult  
Level of ground surface above sea-level (O.D.) 285 ft. If well starts below ground \_\_\_\_\_ ft.  
Shaft \_\_\_\_\_ ft., diameter \_\_\_\_\_ ft. Bore c.s. 240 ft. Diameter of bore at top \_\_\_\_\_ ins., at bottom \_\_\_\_\_ ins.  
Details of permanent lining tubes (internal diameters preferred) ?  
*See sketch on page 6.*

Water struck at depths of (feet) \_\_\_\_\_

Rest-level of water <sup>below</sup> above top of well at mid feet. Suction at 100 feet. Yield on 3000 <sup>gallons</sup> / hour <sup>test</sup> days

" 7000 gallons per hour (with pump of capacity \_\_\_\_\_ g.p.h.); depressing water level to at mid feet below top. Time of recovery \_\_\_\_\_ hrs. Amount normally pumped daily \_\_\_\_\_ g.p.h. for \_\_\_\_\_ hours.

Quality (attach copy of analysis if available) about 17°H

Sunk by Wm. Matthews for Merced San Joaquin Co. Date of well Aug 1925

Information from Drummers installed info for Merced then 1/2 (for low below water) 1/2

(For Survey use only). GEOLOGICAL CLASSIFICATION.		NATURE OF STRATA (and any additional remarks).		THICKNESS		DEPTH	
				Feet.	Inches.	Feet.	Inches.
No details available Nov. 7th 1934.						240	—
H = 170 (about).							
Existing well				24	—	24	—
Hard gray shale				5	—	29	—
Gray shale				24	—	63	—
Gray rock				37	—	100	—
Hard gray shale				17	—	117	—
Black shale				22	—	139	—
Gray rock				12	—	151	—
Gray shale				35	6	186	6
Hard gray rock				3	—	189	6
Very hard gray rock				2	6	191	—
Gray rock				11	—	203	—
Very hard gray rock				7	6	210	6
Hard gray rock				23	6	234	—
* None of these rocks "set" sandstone, but the impure pumping bank could be sand stone 100 ft below surface. [Production from surface bank, not controlled by them.]							
Inf. from S. W. 1/4 Sec. 10, T. 10 N., R. 10 E., S. 10 E.							
— Borehole S. W. 1/4 Sec. 10, T. 10 N., R. 10 E., S. 10 E.							
Analysis by Sheffield Corp. S. W. 1/4 Sec. 10, T. 10 N., R. 10 E., S. 10 E.							
13.5-41 pH 7.0		O. observed (S. W. 1/4 Sec. 10, T. 10 N., R. 10 E., S. 10 E.)		.050			
Hardness (Mohs)		1.0-4.0		Total hardness		21.0	
Chlorides (Cl)		None		Iron		.18	
Ammonia (N)		.040		Manganese		.008	
Alb. N		.006		Rocks following		dry spell.	
N. on nitrate		Nil.				P. 70	

GEOLOGICAL SURVEY AND MUSEUM,  
SOUTH KENSINGTON,  
LONDON, S.W.7.

For Survey use only

Date received Feb. 1939 + 13. iii - 45	C
--	---

G.S.M. Office  
File No.

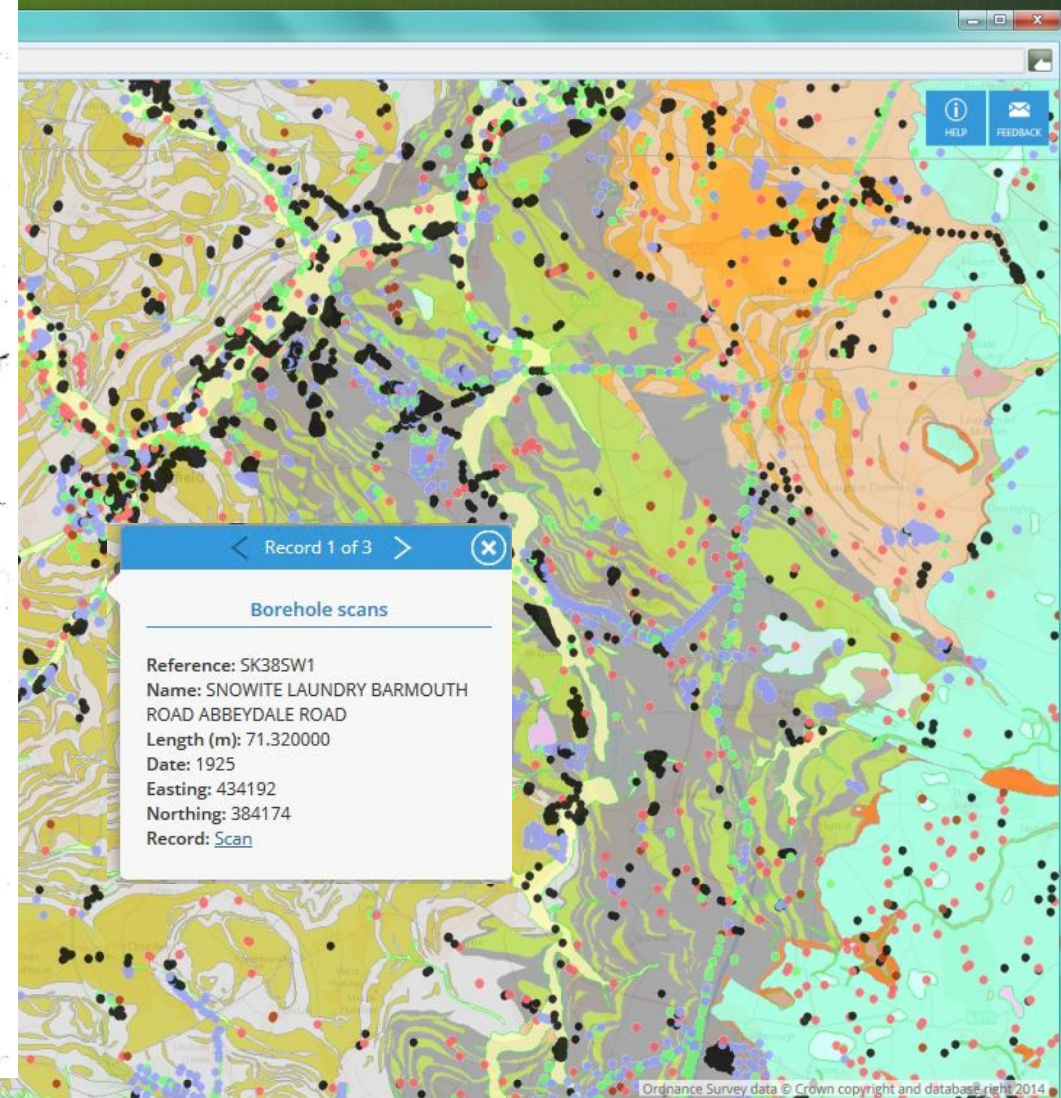
Site marked  
on 1" map.

on 1" map  
(use symbol)

(7093) Wt.36064/0849 5.000 12/13

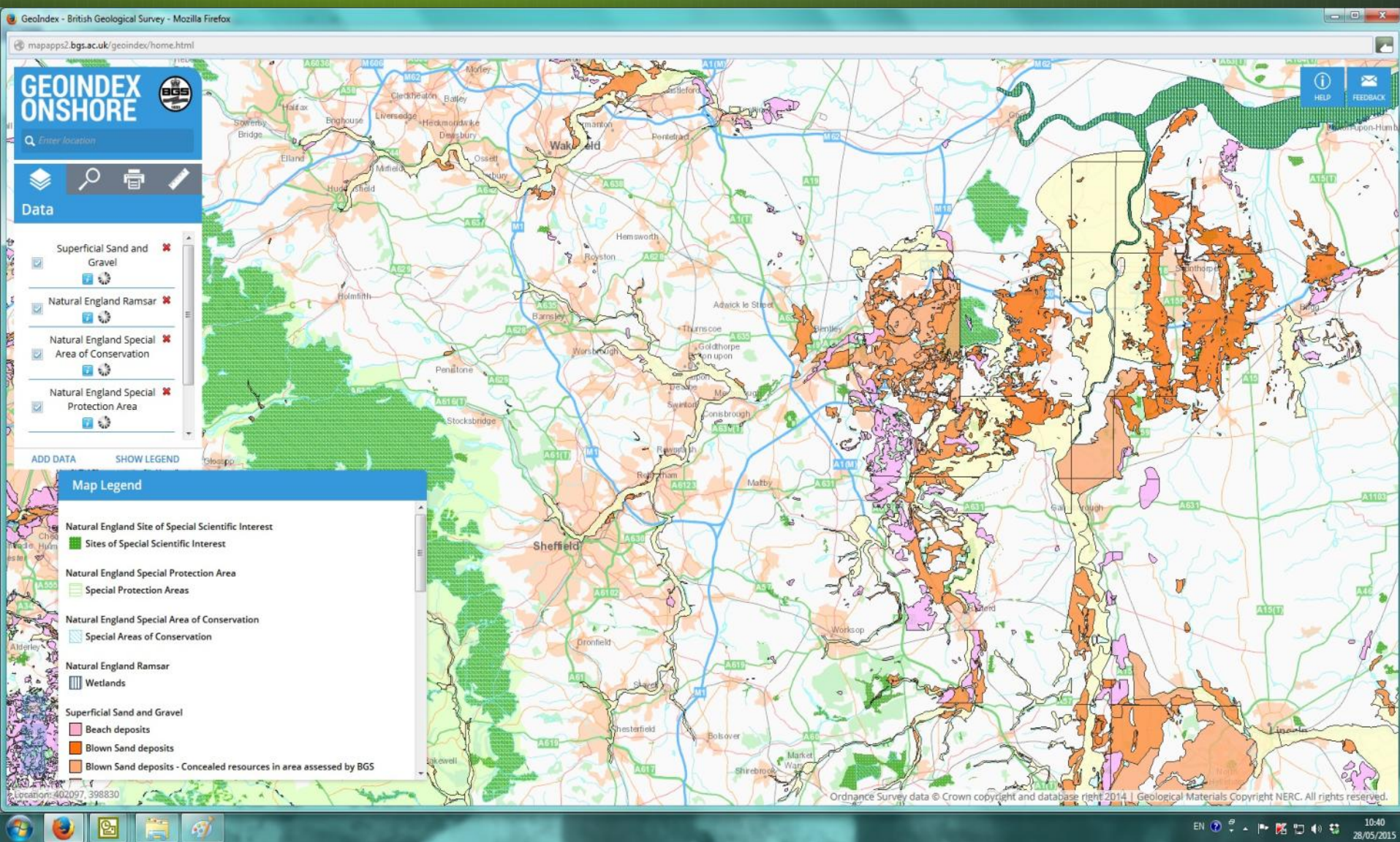
A. &amp; B. W. Ltd. Op. 656

# holes and wells





Nature reserves can be plotted against areas of sand and gravel





# Groundwater level monitoring

Each Environment Agency region operates a groundwater level monitoring network, focussed on the main aquifers in that region

**7300 sites in total for groundwater level**

(EA: 2006 *"Underground, under threat. The state of groundwater in England and Wales"*)

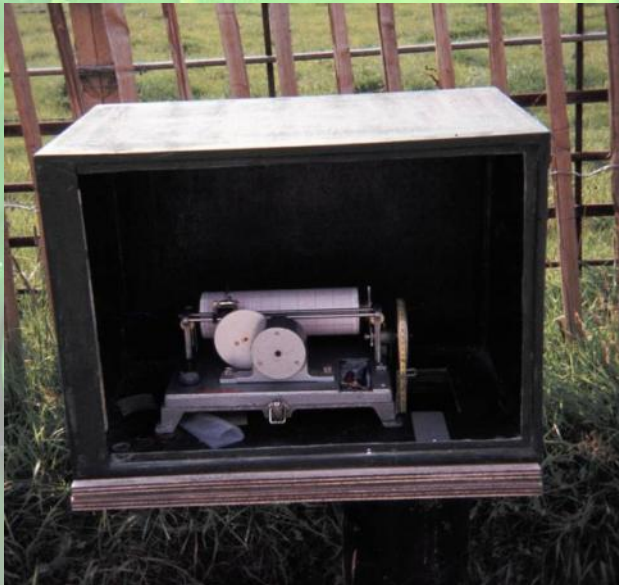




# Groundwater level monitoring

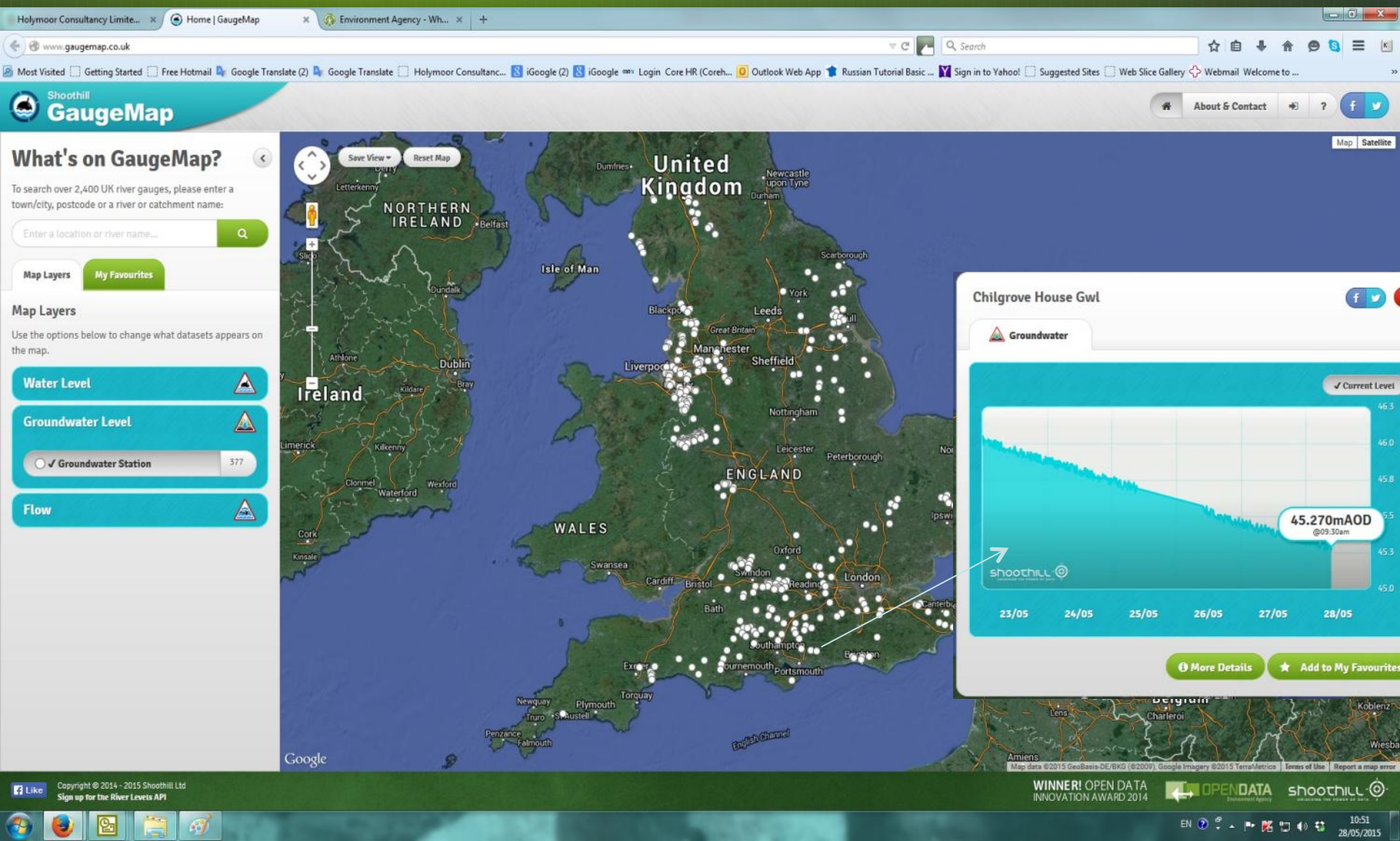
## Monitored wells

- may be continuously monitored: “divers” or clockwork
- may be dipped manually monthly or twice per year



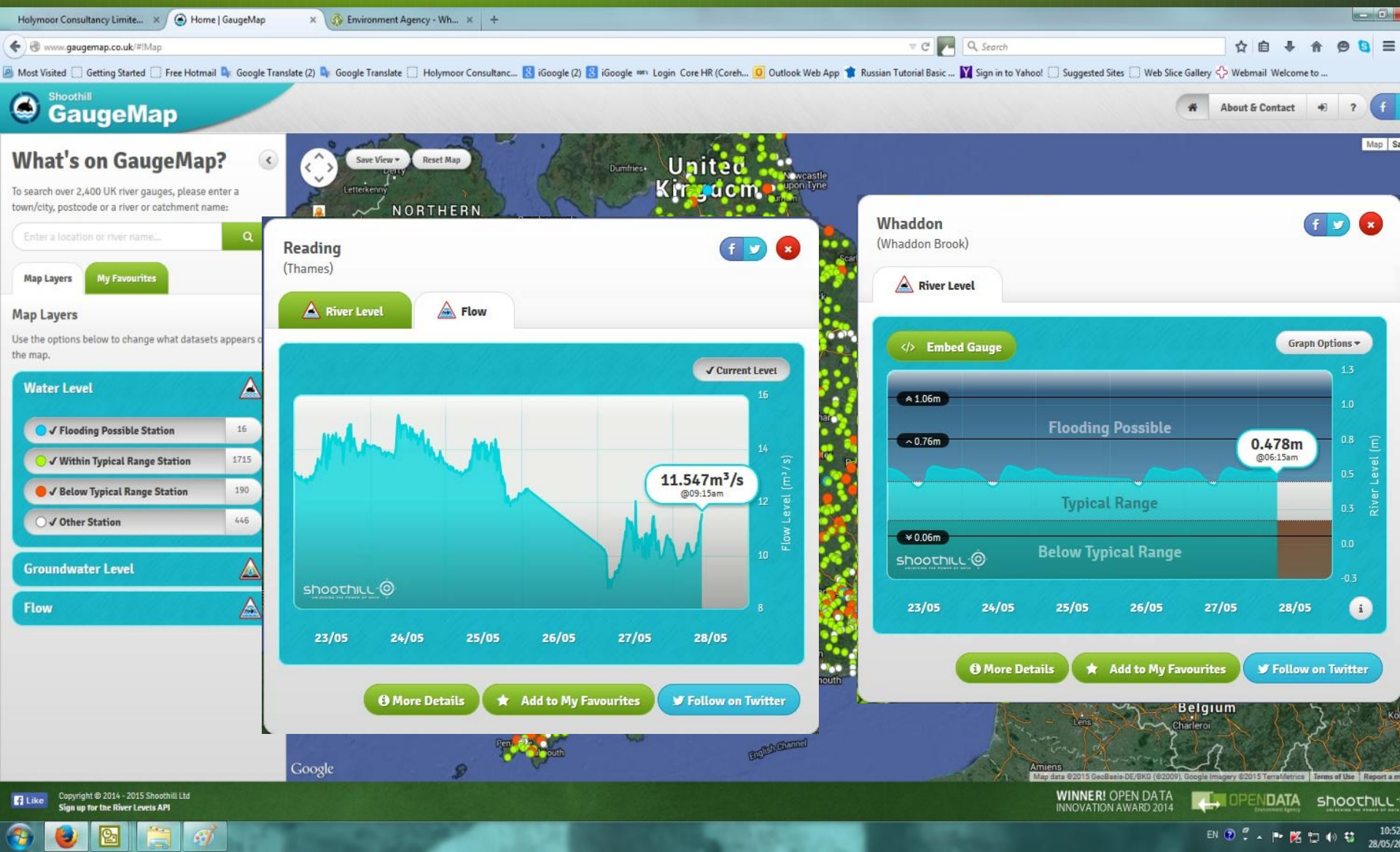


# Real-time level monitoring for groundwater





# Real time level and flow monitoring for surface water

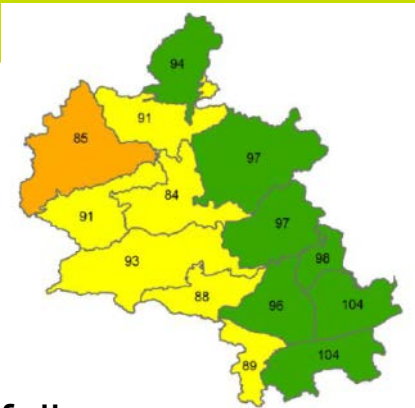
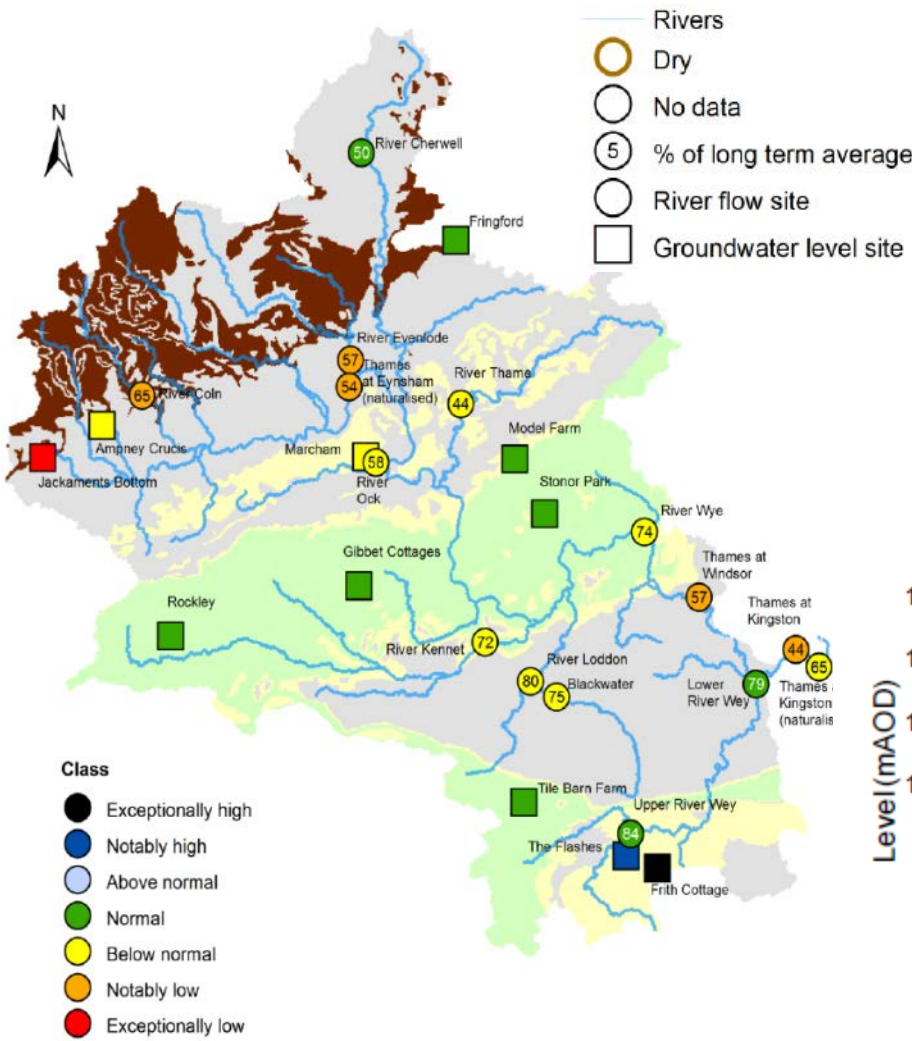






# monthly water situation report

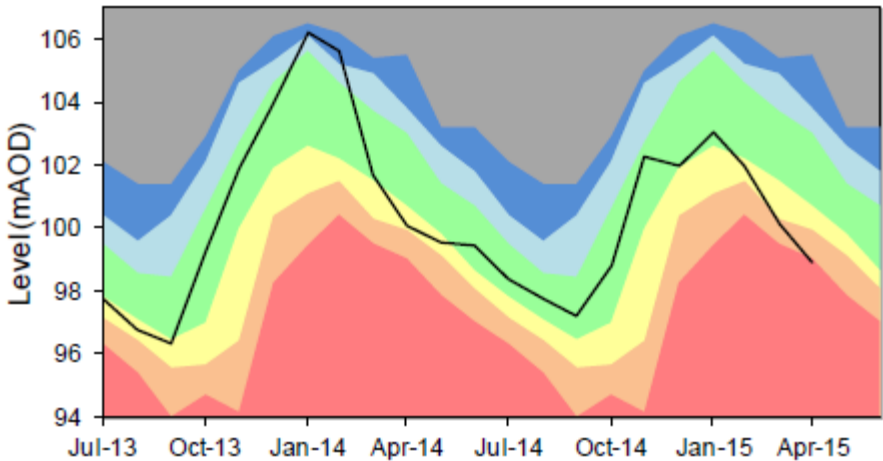
## Thames Region



### Rainfall

Last 12 months

**JACKAMENTS BOTTOM - INFERIOR OOLITE**  
Ranking derived from data for the period Jan-1974 to Dec-2012





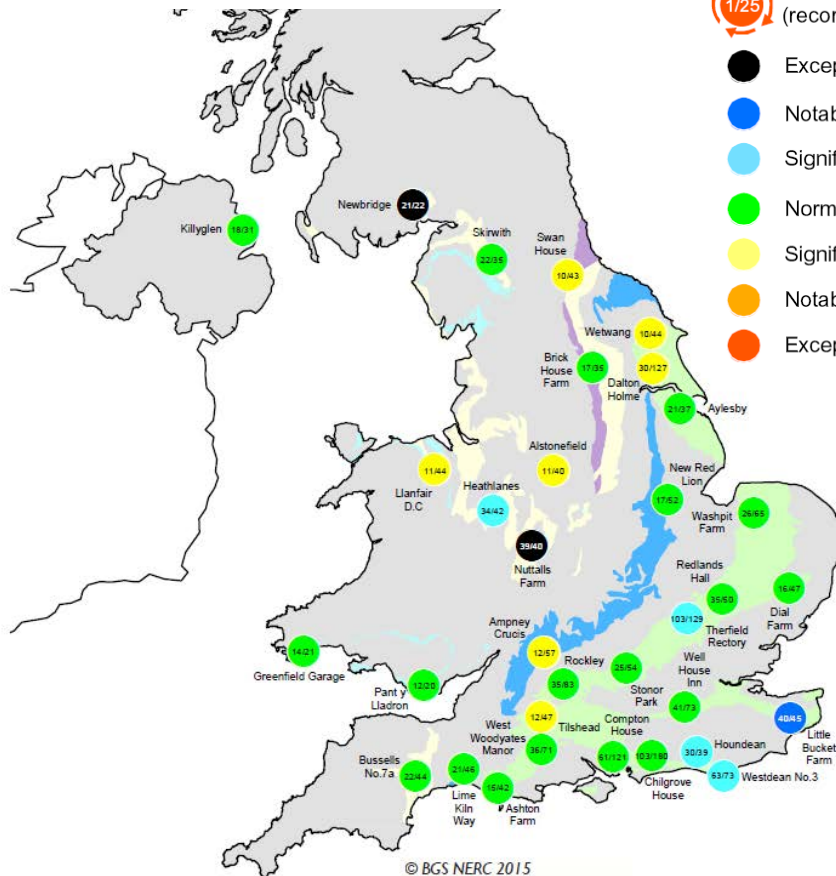
# National resources overview (monthly)

## Hydrological Summary for the United Kingdom



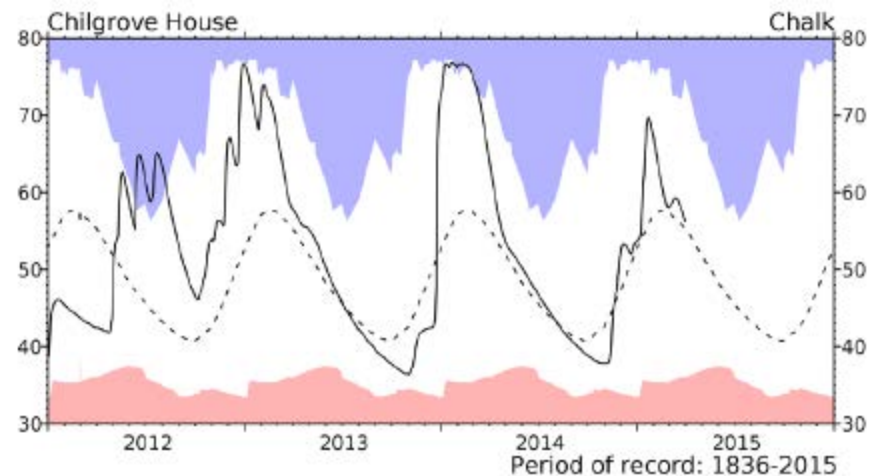
### Key

- Monthly rank/Period of record (record figure when circled)
- Exceptionally high levels
- Notably high levels
- Significantly above average
- Normal range
- Significantly below average
- Notably low levels
- Exceptionally low levels



© BGS NERC 2015

Example: March  
2015. Published by  
British Geological  
Survey





# Management of groundwater supply

Groundwater and surface water are **managed** by the **Environment Agency** on the basis of river catchments.

Each catchment has a **Catchment Abstraction Management Strategy (CAMS)**, where surface and groundwater are considered together

Any abstractor taking  $>20 \text{ m}^3/\text{d}$  requires a licence

Licences are only granted if

- the water balance is positive **and**
- if sufficient water remains to satisfy the catchment's environmental needs **and**
- If there is no negative impact on other abstractors



enhancing... improving  
changing... tackling...  
create a better place...  
advising... managing...

## Don and Rother Licensing Strategy

February 2013

A licensing strategy to manage water resources

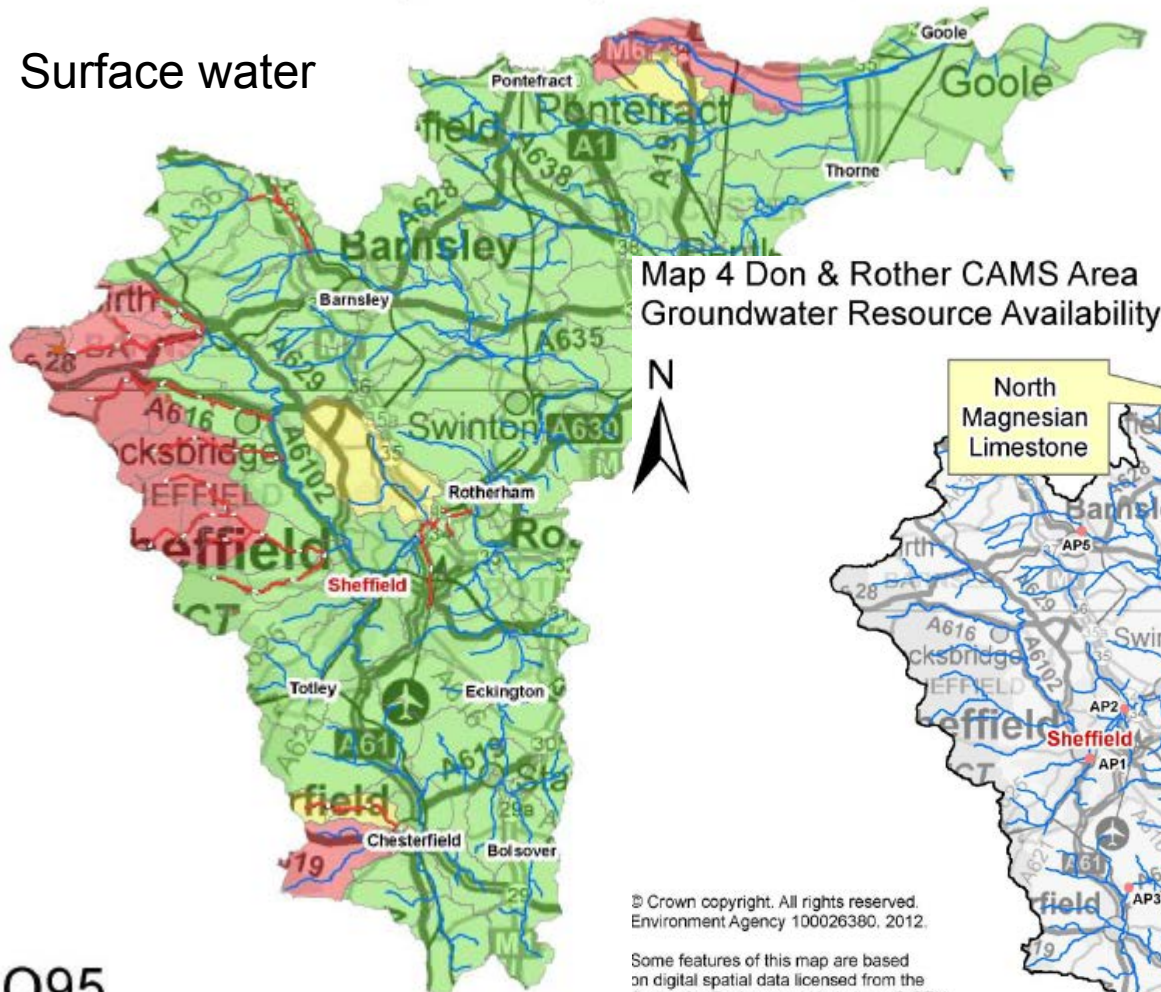
Water resource availability colour	Implication for licensing
High hydrological regime	There is more water than required to meet the needs of the environment. However, due to the need to maintain the near pristine nature of the water body, further abstraction is severely restricted.
Water available for licensing	There is more water than required to meet the needs of the environment. New licences can be considered depending on local and downstream impacts.
Restricted water available for licensing	Fully Licensed flows fall below the EFIs. If all licensed water is abstracted there will not be enough water left for the needs of the environment. No water is available for further licensing at low flows. Water will be available at higher flows with appropriate restrictions. It may also be appropriate to investigate the possibilities for reducing fully licensed risks. Water may be available if you can 'buy' (known as licence trading) the entitlement to abstract water from an existing licence holder.
Water not available for licensing	Recent actual flows are below the EFI. This scenario highlights water bodies where flows are below the indicative flow requirement to help support Good Ecological Status (as required by the Water Framework Directive. Note: we are currently investigating water bodies that are not supporting GES/GEP). Water may be available for further licensing at high flows with appropriate restrictions. Water may be available if you can buy (known as licence trading) the amount equivalent to recently abstracted from an existing licence holder.



# Licensing of abstraction considers need to maintain minimum environmental flows / levels

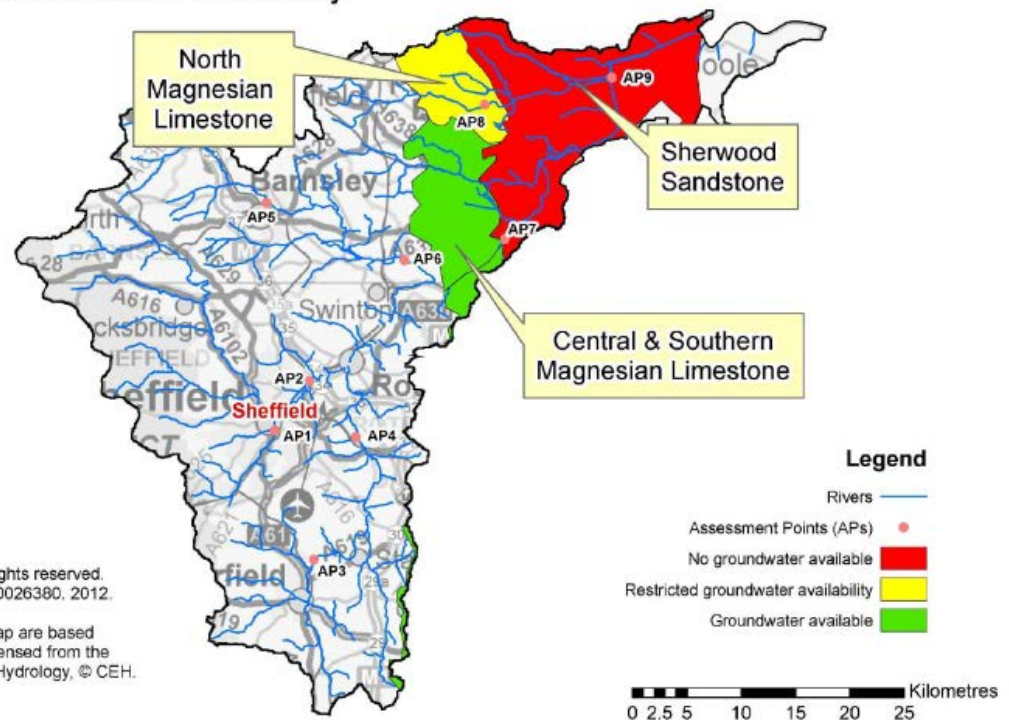
## Water availability at very low flows

Surface water



Map 4 Don & Rother CAMS Area  
Groundwater Resource Availability

Groundwater



© Crown copyright. All rights reserved.  
Environment Agency 100026380, 2012.

Some features of this map are based  
on digital spatial data licensed from the  
Centre for Ecology and Hydrology, © CEH.

Creation date January 2013

Q95

Hydrogeology

Geochemistry

Thermogeology



Enter a postcode or place name:

Other topics for this area...

Water Abstraction Licences

Go

Water Abstraction Licences

## Map legend

Click on the map to see a list of water abstraction licences within that catchment

☒ Water Abstraction Licences within a Catchment

☐ River Catchment

☒ Water Abstraction from Groundwater Sources

★ Small size of abstraction

★ Medium size of abstraction

★ Large size of abstraction

☒ Water Abstraction from Surface Water Sources

● Small size of abstraction

● Medium size of abstraction

● Large size of abstraction

☒ Water Abstraction from Tidal Water Sources

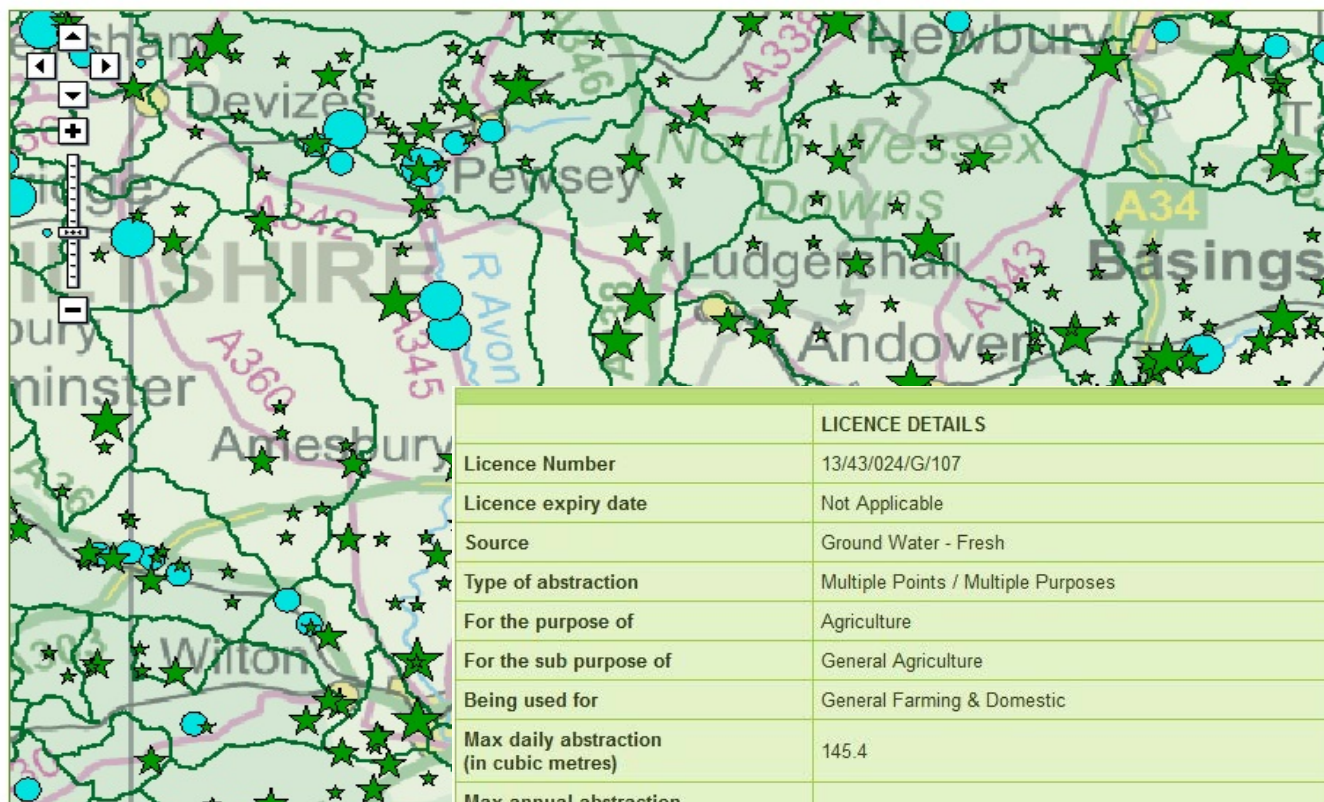
▲ Small size of abstraction

▲ Medium size of abstraction

▲ Large size of abstraction

Map of X: 424,424.15; Y: 145,716.29 at scale 1:300,000

Other maps Data search Text only version



Customers in Wales - From 1 April 2013 Natural Resources Wales will be responsible for issuing and managing water abstraction licences.  
© Environment Agency copyright and database right. Contains Ordnance Survey data.  
This service is designed to inform members of the public.

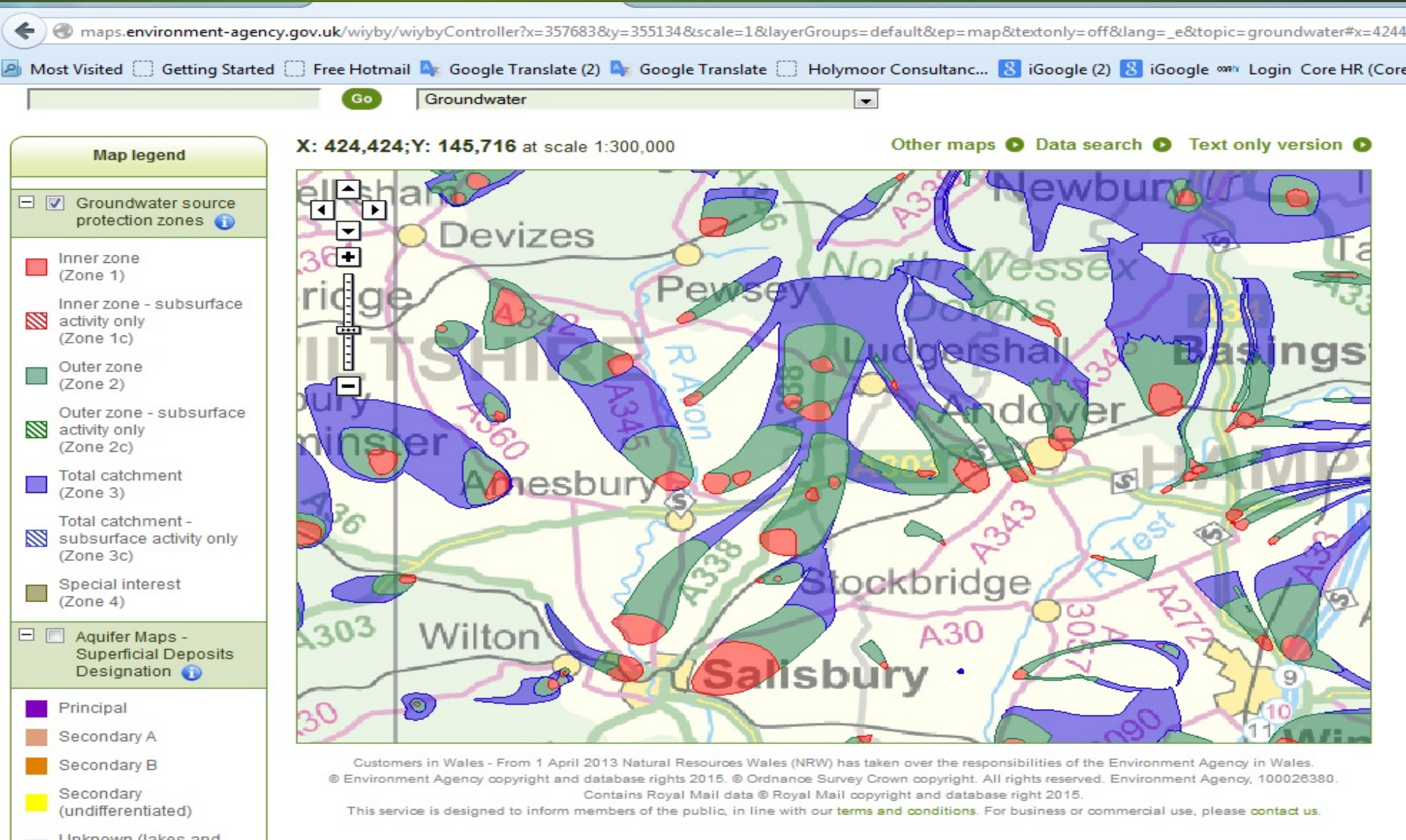
## More about Water Abstraction Licences

## Water Abstraction Licences:

	LICENCE DETAILS	View map
Licence Number	13/43/024/G/107	
Licence expiry date	Not Applicable	
Source	Ground Water - Fresh	
Type of abstraction	Multiple Points / Multiple Purposes	
For the purpose of	Agriculture	
For the sub purpose of	General Agriculture	
Being used for	General Farming & Domestic	
Max daily abstraction (in cubic metres)	145.4	
Max annual abstraction (in cubic metres)	104000	
Start of abstraction period (the date abstraction is allowed to commence in any year)	01-APR	
End of abstraction period (the date abstraction has to cease within any year)	31-MAR	
Name of current licence holder	W R Curnick Ltd	



# Water well source protection zones (from Environment Agency data site)





# Groundwater quality monitoring

Each EA region operates a groundwater quality monitoring network

3500 sites in total for groundwater quality

Sampled between two and six times per year

## Key determinands:

physico-chemical parameters

major anions and cations

minor metals and metalloids (incl. many heavy metals)

nitrogen compounds

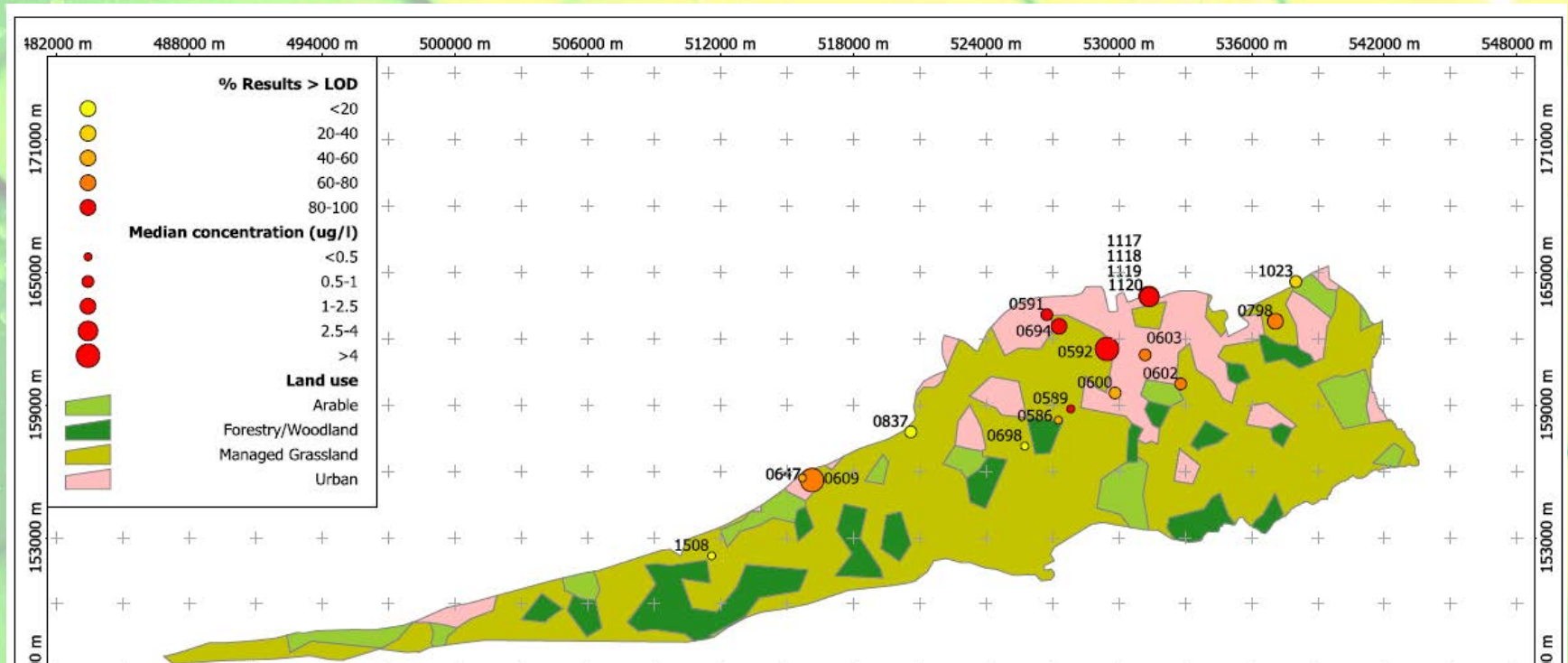
suites of

- pesticides and herbicides
- solvents (chlorinated)
- hydrocarbons / aromatics / MTBE



# EA produce water quality reviews for specific aquifers

e.g. Tetrachloroethene. From EA (2005). *Groundwater quality review: North Downs Chalk*





# Key Points

- Water management is kept “at a distance” from politics
- Water mapping, monitoring and management is not done by Ministries or Departments, but by autonomous public bodies
  - Environment Agency
  - OFWAT
  - British Geological Survey
- Almost all data is freely available and free of charge in the public domain (internet)
  - geology and hydrogeology
  - management strategies
  - wells, boreholes
  - licences
- Integrated management of groundwater and surface water is on the basis of catchments.
- Management is on the basis of a good quantitative understanding of the catchment water balance.