



**Cyfoeth
Naturiol**
Cymru
**Natural
Resources**
Wales

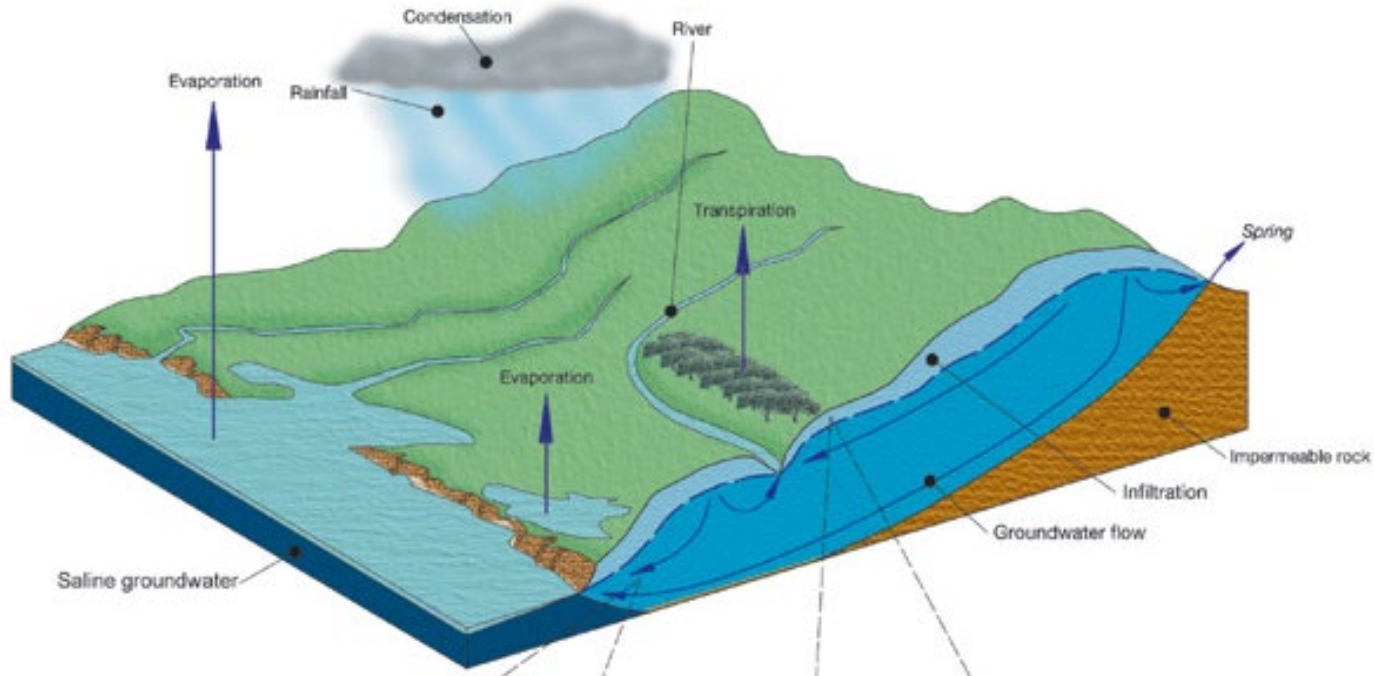


Groundwater in Wales

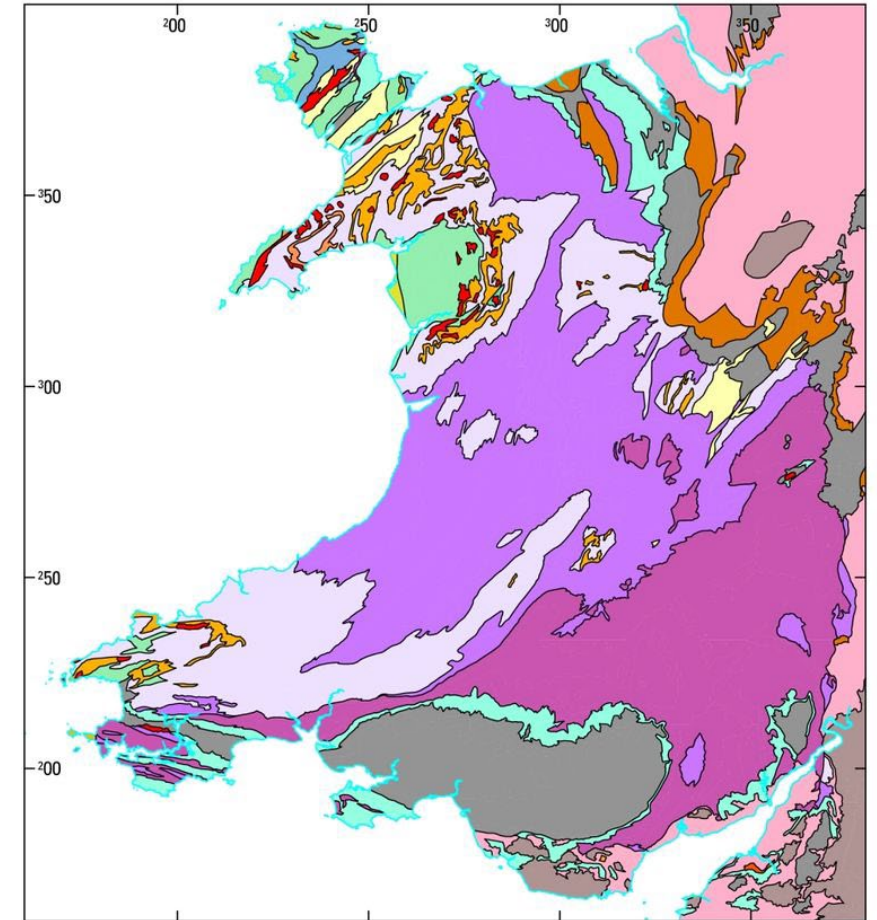
Dave Jones

With thanks to Kay Roberts and Ian Jones

An introduction to groundwater in Wales



British Geological Survey - Hydrogeology of Wales



- | | |
|--|--|
| Palaeogene | Silurian (excluding Old Red Sandstone) |
| Jurassic | Ordovician |
| Triassic | Cambrian |
| Permian | Precambrian (Neoproterozoic) |
| Silesian | } Carboniferous |
| Dinantian and Namurian | |
| Old Red Sandstone (latest Silurian to Devonian) | Intrusive igneous rocks |
| | Extrusive igneous rocks (lavas and tuffs) |

The state of groundwater in Wales

- It's a critical and often forgotten part of the water cycle
'Out of sight, out of mind'
- Sustains springs, rivers, lakes and wetlands
- Vulnerable to pollution, and if polluted difficult to remediate
- At risk from over abstraction and a changing climate



How do we manage and protect groundwater?

- Advise on planning applications for new development
- Issue and regulate licences and permits
- Respond to pollution incidents
- Monitor and report on groundwater
- Conduct research and undertake projects
- Develop policy and guidance

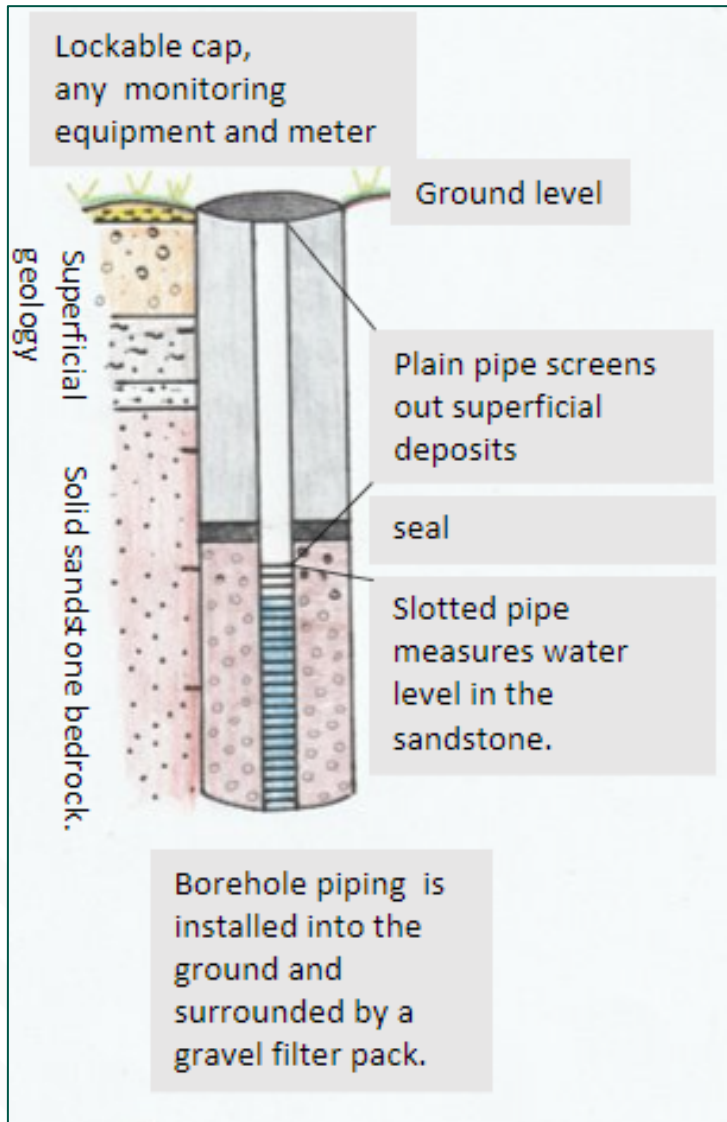


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Groundwater resources in Wales

Measuring groundwater levels



Our groundwater level monitoring network

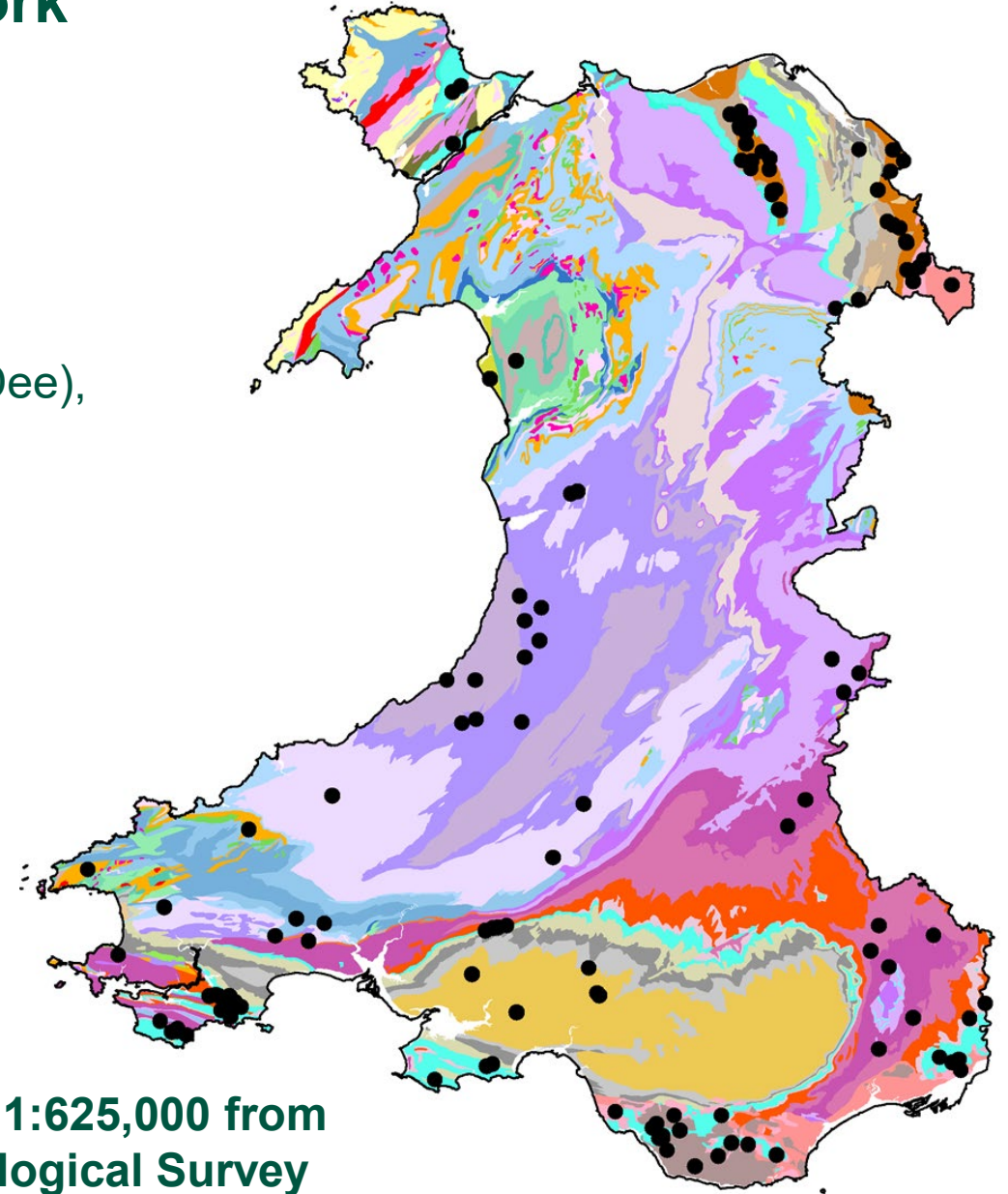
A total of 134 monitoring points (as boreholes)

Coverage based on:

- Project Clusters – North East Wales (Clwyd and Dee), South West Wales (Pembrokeshire) and Northern Limestone Outcrop.
- Specific catchments

Areas previously avoided

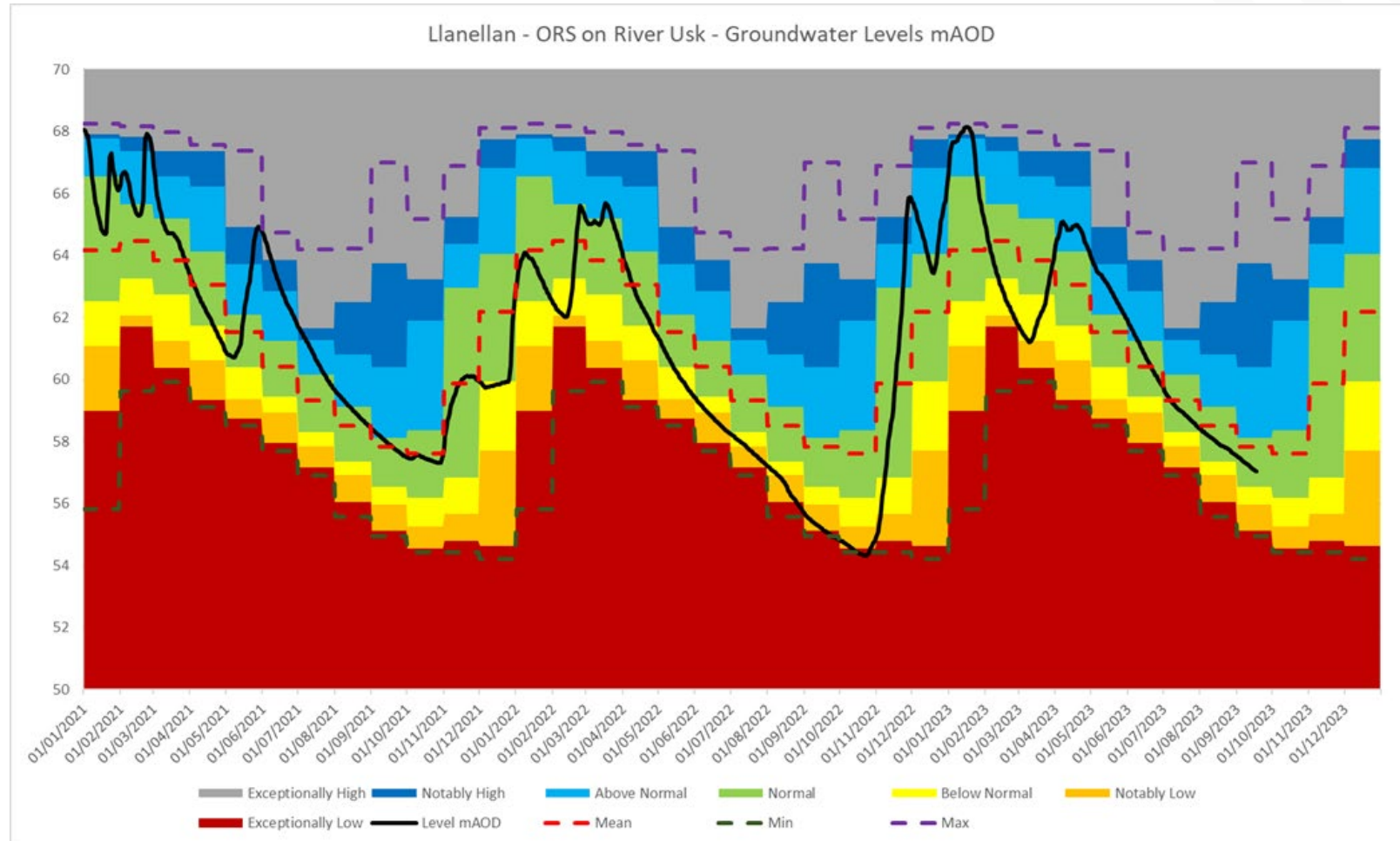
- South Wales coalfield – explosion risk
- Mid-Wales with River Severn catchment – formerly EA Midlands Region (England)



Geology @ 1:625,000 from
British Geological Survey

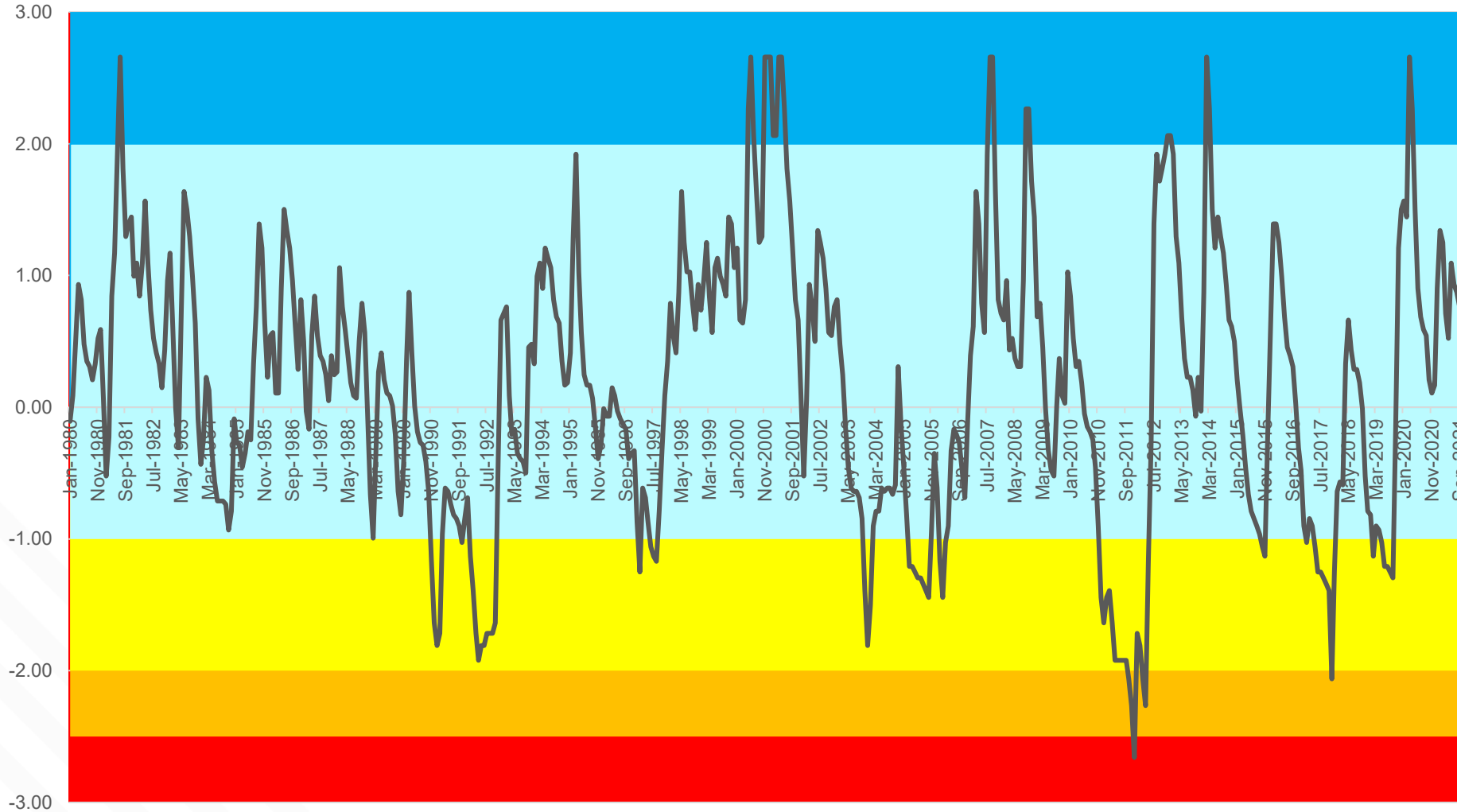
What is the groundwater level monitoring network used for?

- Site specific data
- Abstraction licensing strategies
- Water Framework Directive classification
- Modelling
- Drought assessment
- Water quality sampling



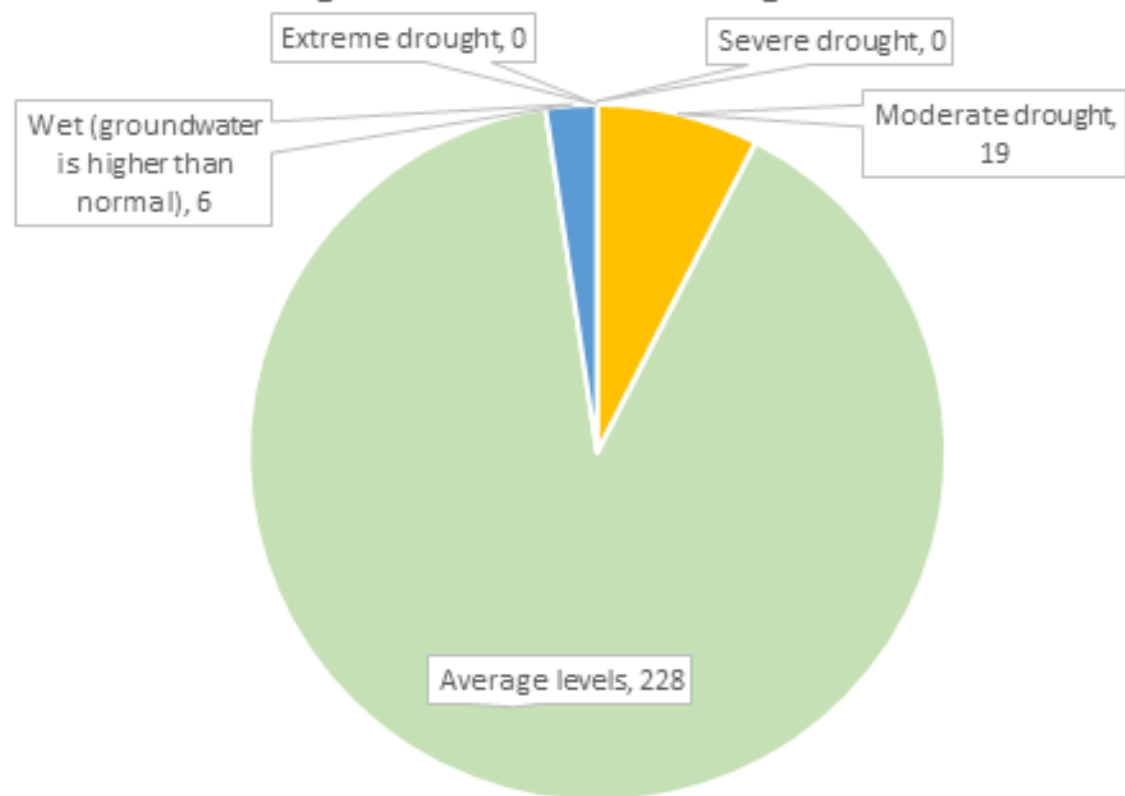
Introducing the Standardised Groundwater Index

Fedw Wood - 1980 to present

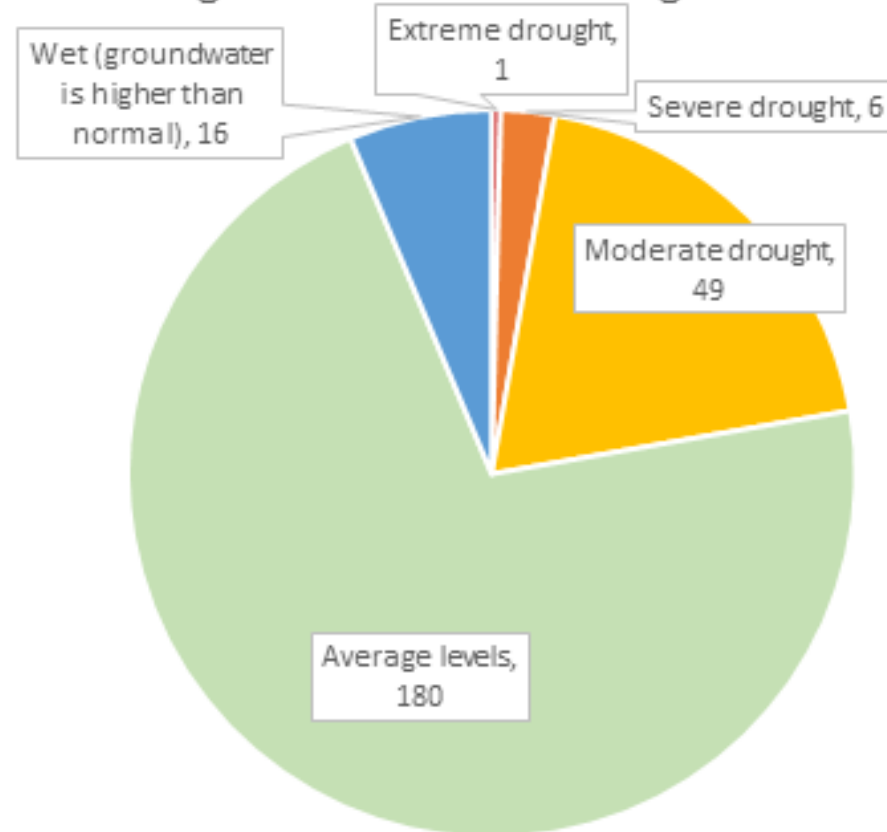


- Wet
- Average
- Moderate drought
- Severe drought
- Extreme drought

Fedw Wood 1980 to 2000 months spent in different groundwater level categories



Fedw Wood 2001 to 2021 months spent in different groundwater level categories





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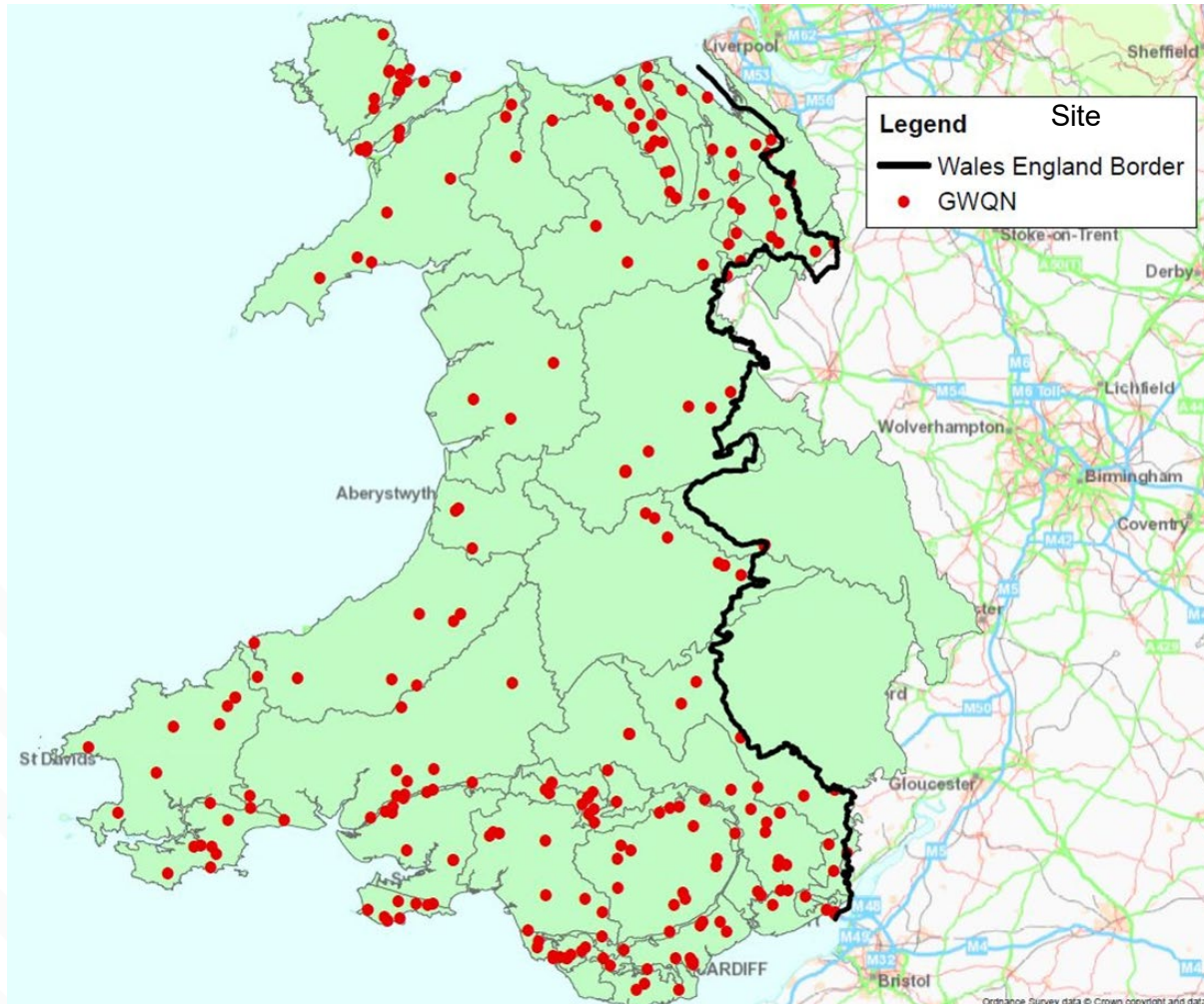
Groundwater quality in Wales

Why do we monitor groundwater quality in Wales?

- Good groundwater quality is critically important for nature and water users
- NRW is required by law to monitor groundwater quality
- Support our reporting obligations, esp. WFD
- As an evidence base to support wider work of NRW:
 - environmental permitting,
 - abstraction licencing,
 - management of protected sites,
 - data requests
- Determine background & baseline groundwater quality
- Understand where quality changes occur & why



How do we monitor GW Quality?



We have a groundwater Quality Network (GWQN)

Currently 159 monitoring sites

Mix of NRW's own boreholes and springs, wells and boreholes owned by others.

Some examples of monitoring sites



DCWW Spring Intake
Dinas Mawddwy



Penmon Priory
Well, Anglesey



Metal Mine Adit
Flintshire



Private Water Supply



Beach Spring
Anglesey



Factory Borehole
Llyn Peninsular



DCWW Artesian BH
Vale of Clwyd

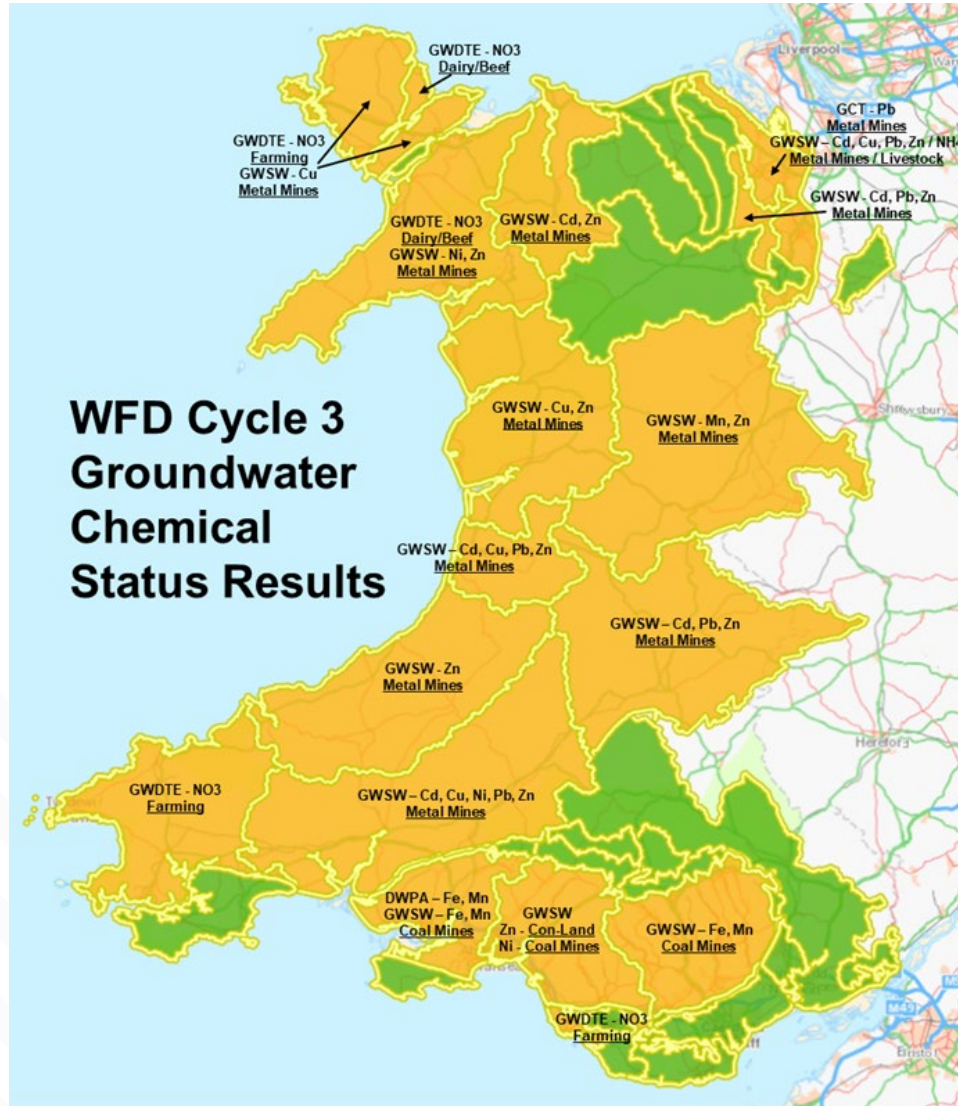
What do we test for & how often?

Suite	Suite name
I1	Field parameters (temperature, pH, electrical conductivity, dissolved oxygen, oxidation-reduction capacity, turbidity)
I2	Anions and metals (total – unfiltered)
I3	Dissolved metals (filtered)
I4	Special inorganics, e.g. arsenic, bromate etc.
O1	Organophosphate pesticides
O2	Organochlorine pesticides
O3	Acid herbicides
O4	Uron/urocarb pesticides
O5	Phenols
O6	Volatile organic compounds
O7	Poly-aromatic hydrocarbons
O8	Special organics, e.g. flumethrin, cypermethrin
M1	Microbiology
G1	Dissolved gases

- 14 analyte suites with a total of ~333 analytes
- Not all suites are sampled at all sites;
- GCMS Organics & LCMS semi-quantitative scans for ~2,500 analytes
- 2023 we started sampling for PFOS & PFOA (~70 sites)
- Currently sampling 1x to 2x per year

I = inorganic, O = Organic, M = Microbiological, G = Gases

How do we use the data?



38 Groundwater bodies, of these:

- 21 Good Status
- 17 Poor Status

Reasons for not achieving good status:

- Metal mines – 11
- Farming – 6
- Coal Mining – 3
- Contaminated Land – 1

Principal failing analytes:

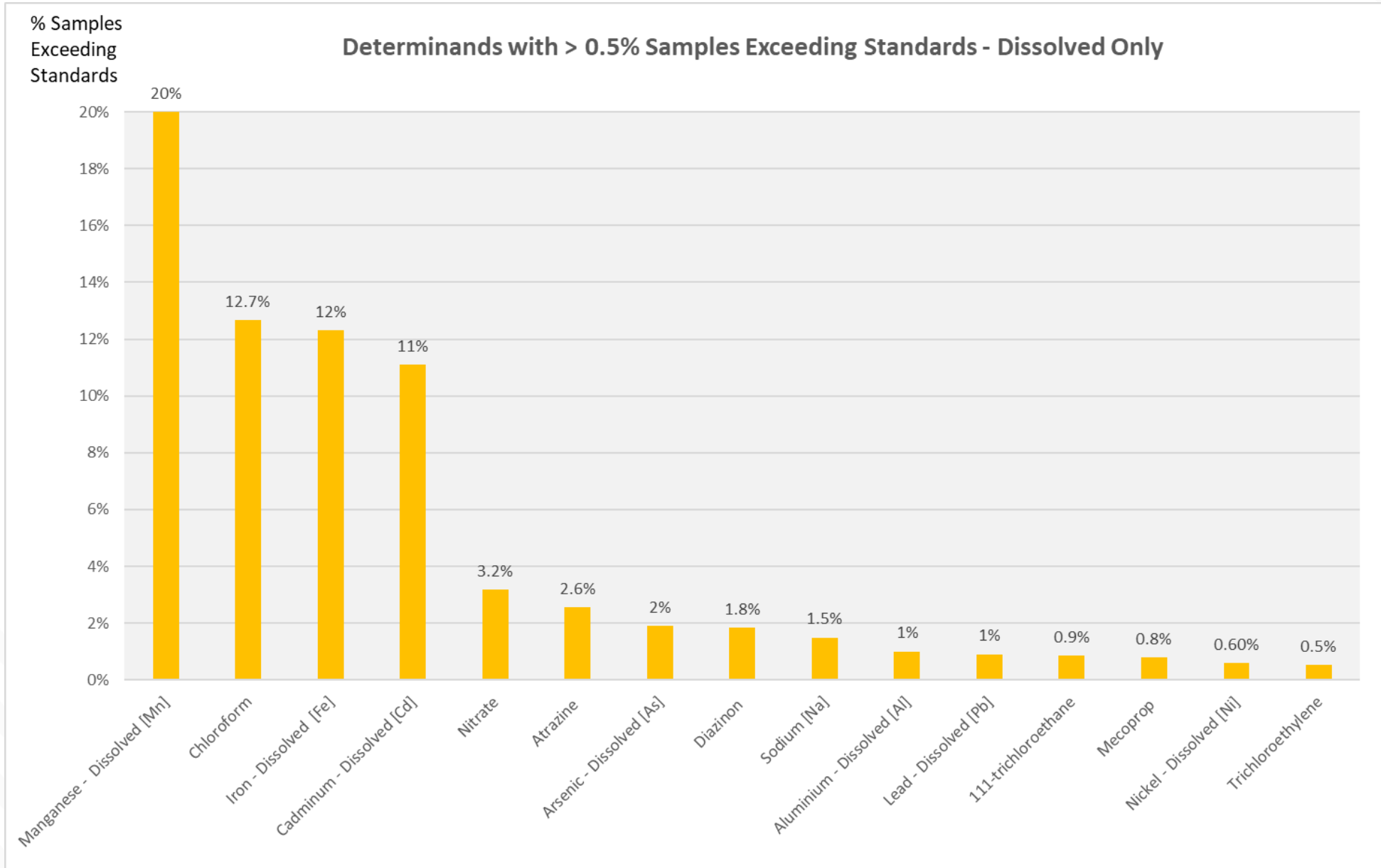
Zn, Cd, NO₃, Pb, Cu, Ni, Fe, Mn, NH₄

Data available on Water Watch Wales

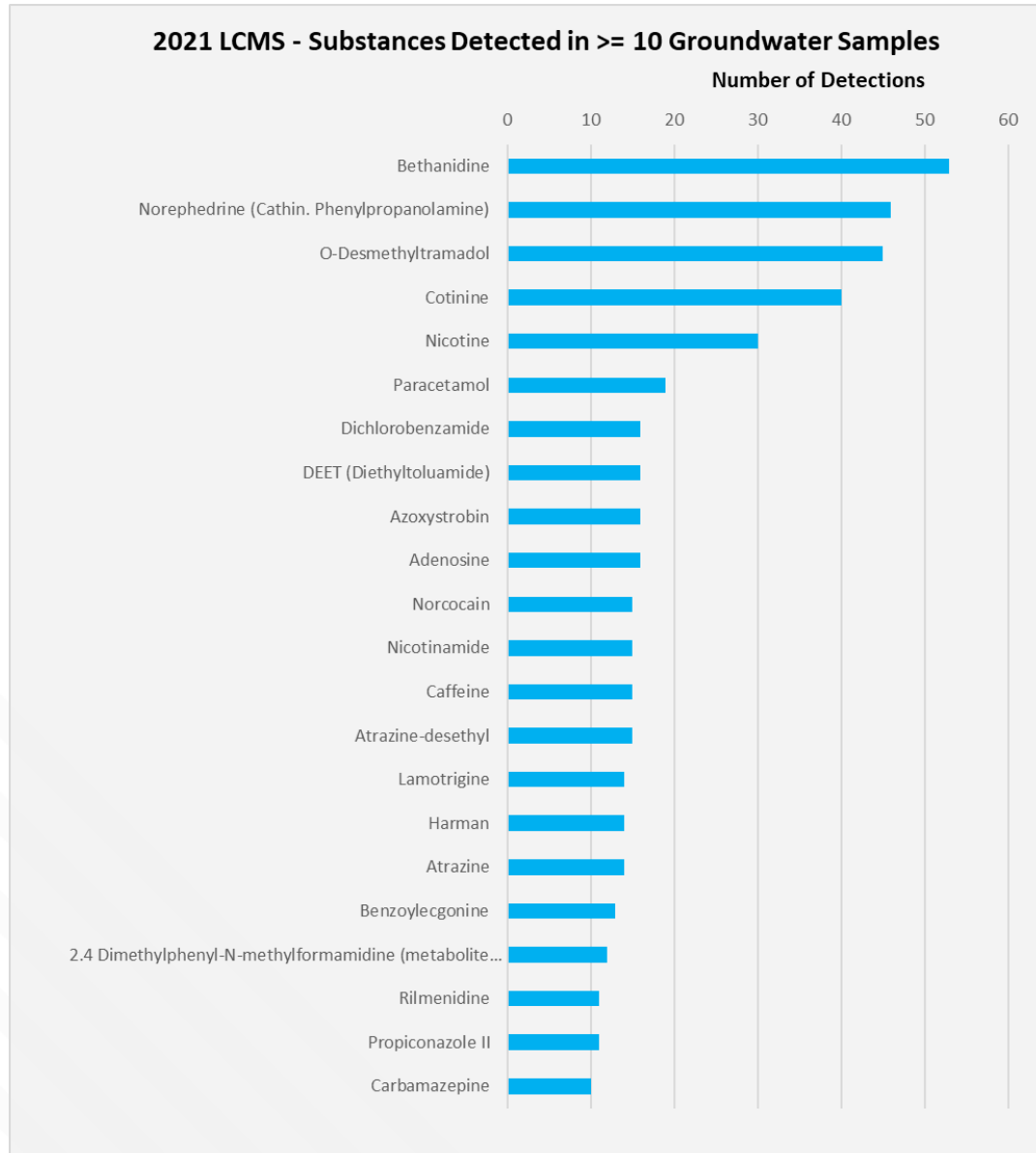
State of Our Groundwater (Quality) 2009 to 2021

- Groundwater quality (2009-2021) was assessed by comparing the analysed determinands with:
 - UK Drinking Water Standards (DWS)
 - Groundwater Hazardous Substances Standards (GHSS)
- **122** occur in the Drinking Water Standard list
- **89** in the Groundwater Hazardous Substances Standards list
- **50** occur in both lists.

Groundwater quality 2009 to 2021 - summary



Emerging contaminants in groundwater



- Substances which are not yet regulated but may be of environmental or human health concern
- Liquid chromatography–mass spectrometry (LCMS) semi-quantification scans of 2,269 substances, including: medicines, cleaning & personal care products, pesticides
- These were the most frequently detected in 2021 sampling round

Groundwater quality summary

- Based on our GWQN data, groundwater quality in Wales is generally in good health but continues to be affected by the legacy of coal and metal mining, intensive land use activities such as agriculture, and localised pollution incidents.
- Emerging contaminants pose a threat and we need to learn more about where they are, and what it means for groundwater in Wales over the longer term.
- We are working to make our data more easily available through PowerBI on our website.
- In the near future we intend to use more NRW & 3rd-party data (DWI, DCWW, Hafren Dyfrdwy) to support our work.



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Our priorities for groundwater in Wales

Our priorities for groundwater in Wales

- We want a plentiful supply of clean groundwater for people and the environment
- We can't do this alone and will need to work with others
- We will continue collecting evidence and developing our scientific understanding of groundwater
- We will make the best use of our regulatory powers to manage activities affecting groundwater
- Over the next 5 years our priorities for groundwater management and protection are:



1. Review our monitoring networks

- Ensure we're monitoring for the right things in the right places
- Help us to understand what's changing, where, and how we need to react
- We likely to need more monitoring points in urban areas
- We need a better coverage of shallow groundwater



2. Investigate the threat of emerging contaminants

- Have capability and capacity to monitor for emerging contaminants in groundwater across Wales
- Determine the current scale of the problem - where in Wales they appear most and why
- Assess if our regulatory approach remains fit for purpose



3. Reduce nutrient inputs to groundwater

- Spreading of organic material to land is a potential sources of excess nutrients to groundwater
- Excess nutrients can travel through the subsurface and reach our streams, rivers and lakes
- Can also be a source of emerging contaminants to the wider environment
- We need to improve our understanding of how these substances behave in the ground
- This will inform our policies for controlling the activity in high-risk locations



4. Adapt to the threat posed by a changing climate

- We expect to see an increase in seawater intrusion to groundwater near the coast.
- Flooding from groundwater may become more common
- Changing rainfall patterns means springs and other shallow sources are likely to dry up more often.
- Need to understand where this might happen and advise what mitigation, if any, is possible.
- Demand for renewable sources of heating and cooling such as ground source heat pumps is likely to increase the pressures on groundwater in urban environments
- We need to assess where increased demand for groundwater might occur and ensure we have appropriate ways of regulating these uses



How can you help us?

- If you have any experience in these topics let us know
- Point us towards ongoing research or relevant contacts
- Work with us to develop research projects



For more information

[How we can all help protect groundwater in Wales](#)

[River Basin Management Plans](#)

[Water Watch Wales](#)

[British Geological Survey – Hydrogeology of Wales](#)

[UK Groundwater Forum](#)



Contact us: geoscience@cyfoethnaturiolcymru.gov.uk

Diolch / Thank you

