



Department
for Environment
Food & Rural Affairs

The advent of biota monitoring for environmental and human health protection – Water Framework Directive (WFD)

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Overview of the presentation

- **The WFD – what it is, key aims**
- **Assessing status of surface waters**
- **WFD's priority substances & Environmental Quality Standards (EQS)**
- **Implementation of biota-based EQS & results**
- **Issues of applying EQS[biota]**
- **Remarks for the near future.**

Water Framework Directive (WFD) – What is it?

Comprehensive EU water management & policy legislation

- **Ambitious.** It's aim (back in 2000) was to achieve good ecological status in all waters (fresh and transitional waters) by 2015, with the ultimate deadline of 2027.
- **Framework.** Complemented by other EU water legislation – Nitrates, Urban Waste Water Treatment, Drinking Water, Bathing Waters, Habitat Directives, etc.
- Two WFD “daughter” directives relating to chemical contaminants in water.
 - **Environmental Quality Standards Directive** (reduce pollution from chemicals) &
 - **Groundwater Directive** (reduce pollution of groundwater)

Specifically, WFD aims to:

- ❑ Enhance the status of aquatic ecosystems incl. wetlands
- ❑ Promote sustainable water use
- ❑ **Progressively reduce surface water pollution from priority substances & cease / phase-out emissions, discharges & losses of priority hazardous substances**
- ❑ Prevent deterioration / reduce pollution of groundwater
- ❑ Contribute to mitigating effects of floods / droughts.
- ❑ **Key objectives:**
 - Prevent deterioration in water quality status
 - Achieve 'good status' in surface & ground waters by 2027

WFD 'in a nutshell'

What

Management of all natural waters for sustainable use



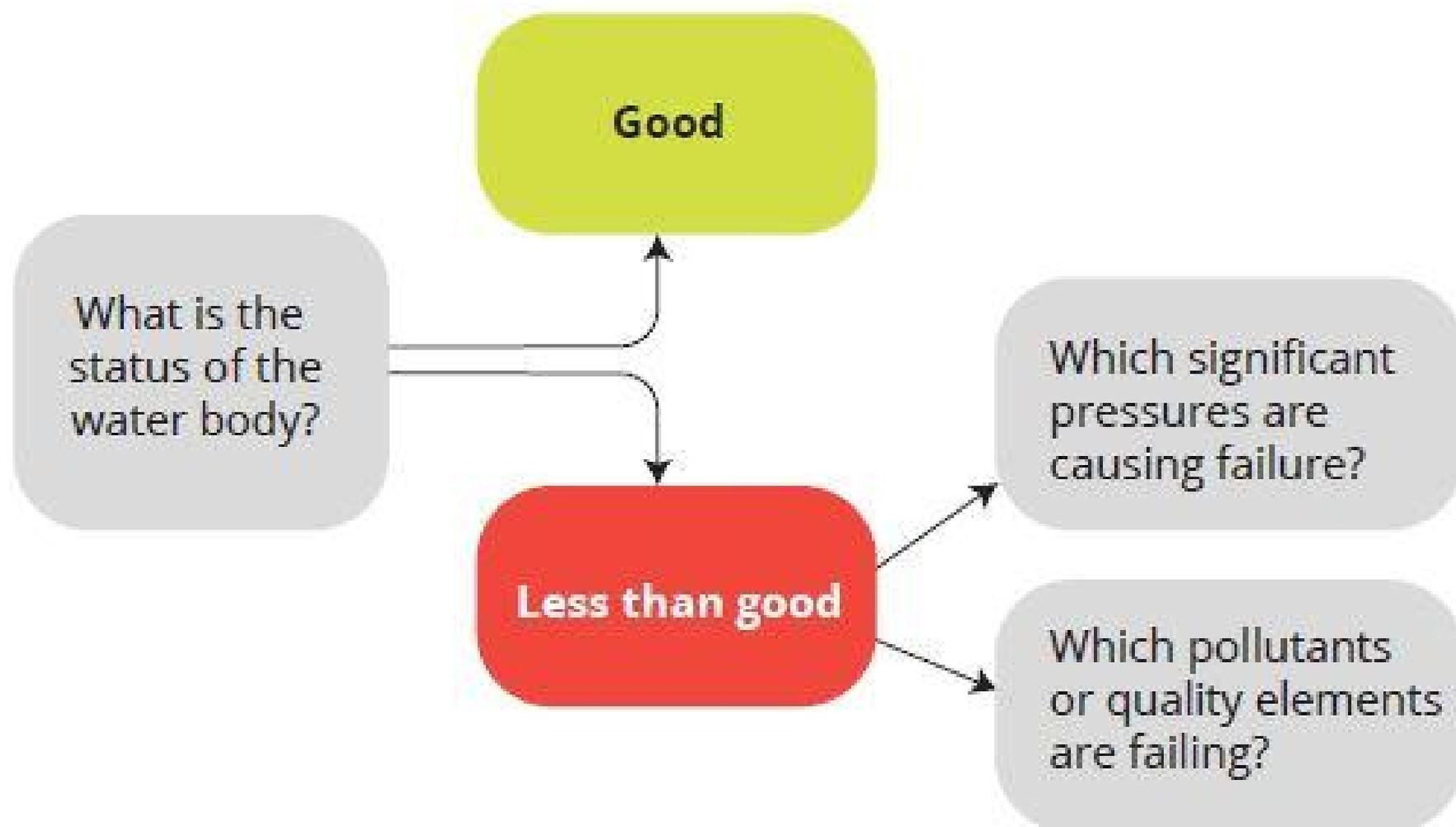
How

- Assesses status ('high' to 'bad') of water bodies
- For any waters that show anything greater than slight impacts, develop a **River Basin Management Plan (RBMP)** to aim to ameliorate & ensure that current impacts do not get worse. 3rd RBMPs due in 2021.

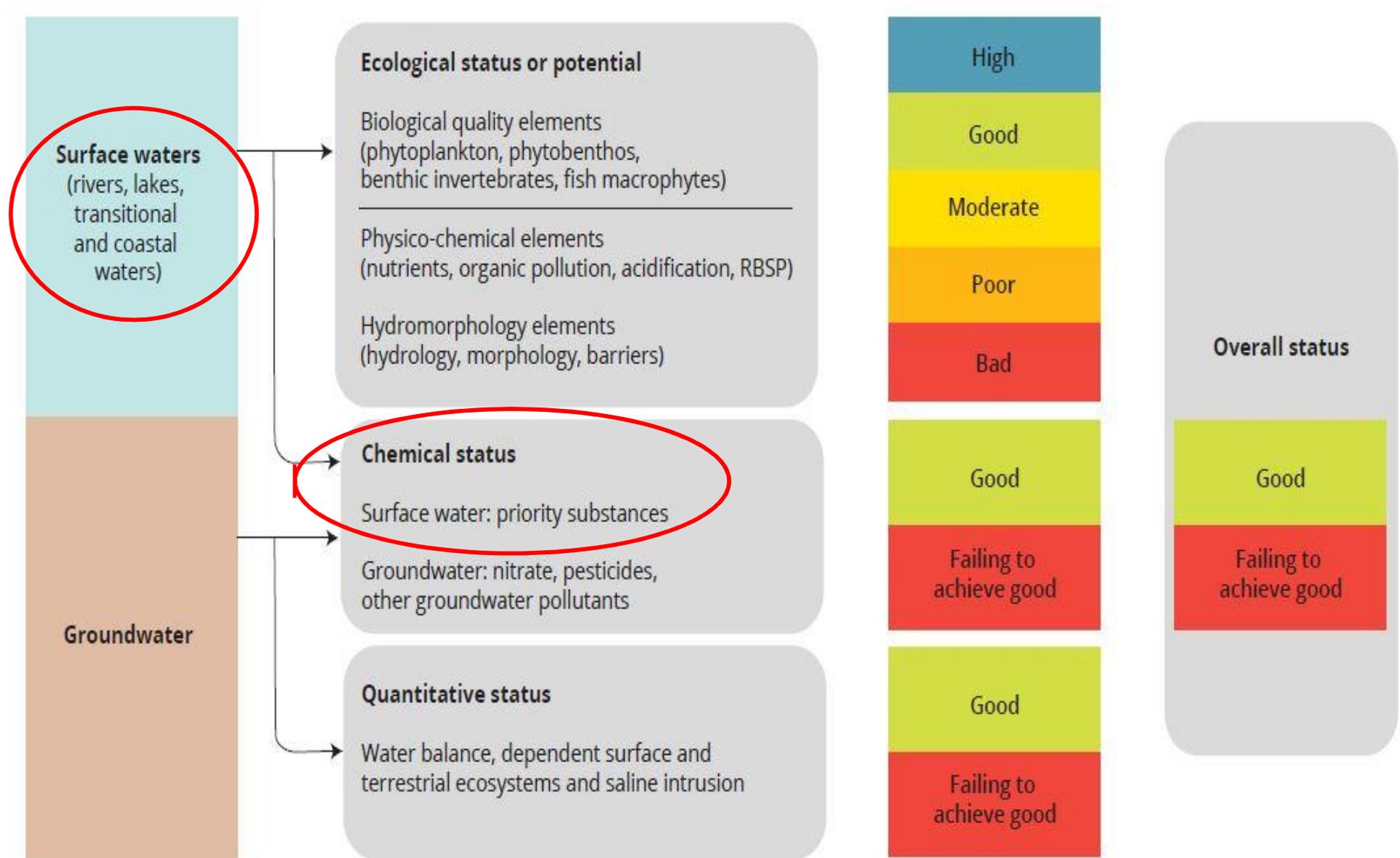
Who

- **Environment Agency** measure impacts, develop RBMPs for England
- **Defra** takes overview of economic assessments, and
- **Ministers** decide ambitions.

Determining good status

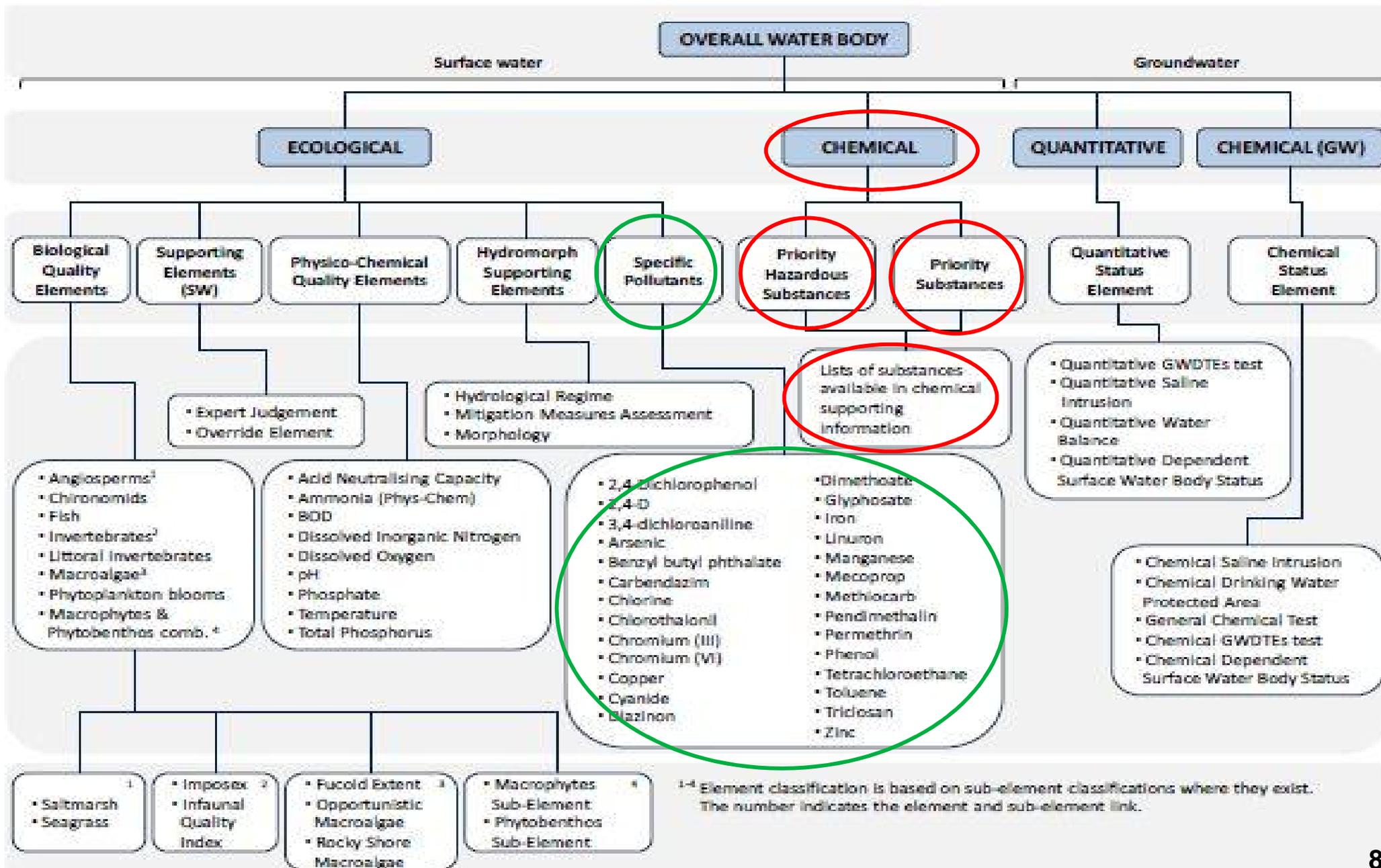


Chemical status of surface waters



Where chemicals fit into WFD

Classification steps working towards overall status of water bodies



Priority Substances – what are they?

- ➔ Hazardous substances that pose a risk to wildlife or people via the aquatic environment
- ➔ Priority Substances listed in WFD and EQS Directives (2000, 2008, 2013)
- ➔ Why do they matter?
 - ➔ EU-wide Environmental Quality Standards (EQS)
 - ➔ MSs must monitor and achieve compliance with these EQSs
 - ➔ 'Cease and phase out' of the most hazardous substances (PHSs)



WFD's PS & PHS & water & biota EQS

Environmental Quality Standards Directive (2008/105/EC)

33 priority substances protecting HH and secondary poisoning of wildlife

Water-based EQS ($\mu\text{g/L}$).

- ❖ PAHs, PBDEs, Cd, Pb, Ni, pesticides, TBT, phthalate, OP & NP, SCCP.

Priority Substances Directive (2013/39/EU)

12 'new' substances added

Biota-based EQS ($\mu\text{g/kg w.w.}$) introduced

Biota = fish / crustacea / bivalve molluscs

Persistent, Bioaccumulative & Toxic (PBT) substances

- ❖ Hg, fluoranthene, PAHs (from crustacea / mussels only), PBDEs, HBCDD, PFOS, dioxins-furans-dl-PCBs, dicofol & heptachlor, HCB & HCBd.

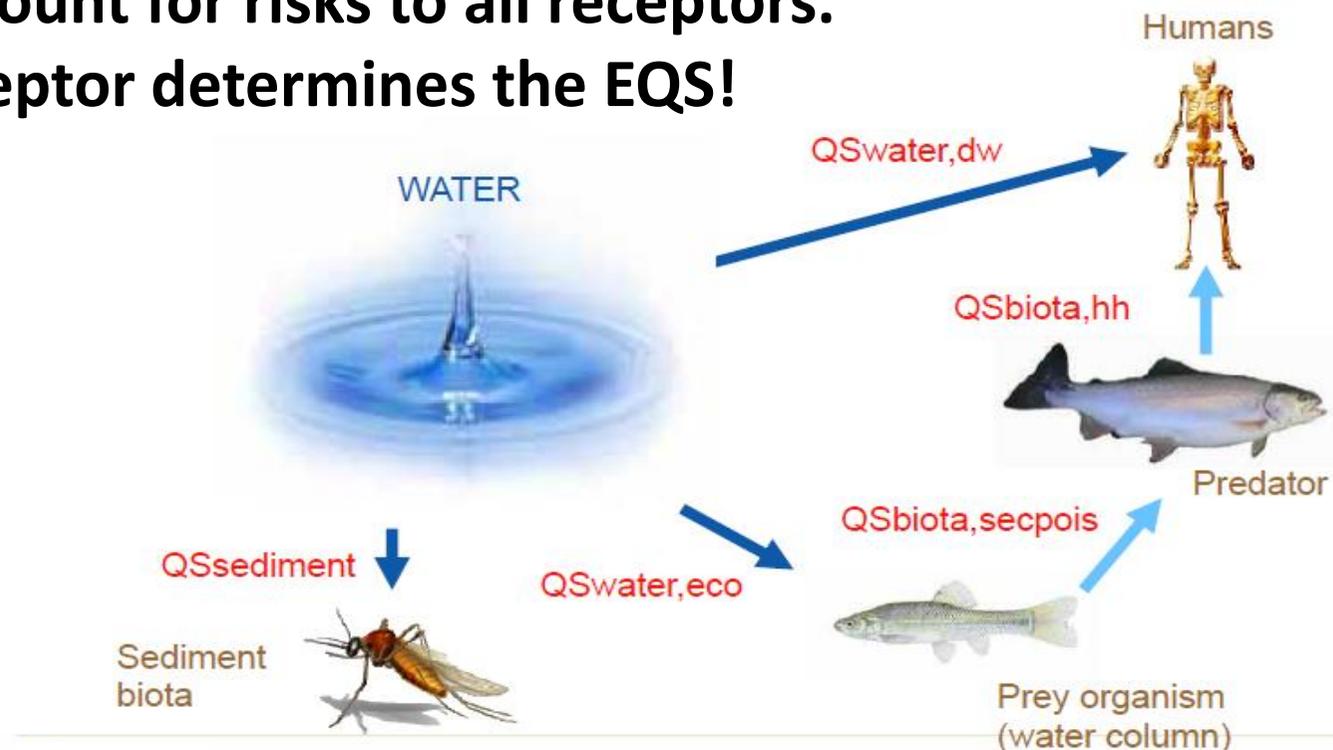
UK Specific Pollutants

- **EQS[water]** – pesticides, metals - assessed as part of ecological status & to protect against ecotoxicological effects / impacts on aquatic organisms.

Deriving an EQS

- EQS value needs to account for risks to all receptors.
- The most sensitive receptor determines the EQS!

Identify substance
↓
Identify receptors at risk
↓
Collate & quality-assess data
↓
Determine an EQS value
↓
Propose & adopt the EQS



WFD's Common Implementation Strategy's Tech. Guidance Document No. 27

EQSs – a key tool for assessing chemical status and controlling emissions

- ➔ Environmental Quality Standard
- ➔ Threshold concentration below which we do not expect adverse effects to occur
 - ➔ Hazard-based
 - ➔ Usually for individual chemicals
 - ➔ Only meaningful when we compare EQS to environmental concentrations (measured or predicted) → Risk



PBT substance	EQS[biota] (µg/kg)	PBT substance	EQS[biota] (µg/kg)
PBDEs & HBCDD	0.0085 167	Perfluorooctane sulfonic acid (PFOS)(#)	9.1
Fluoranthene	30	Heptachlor	0.0067
PAHs [benzo(a)pyrene] (*¥)	5	Dicofol	33
Dioxins, furans & dl-PCBs (¥☒#)	0.0065 (TEQ sum)	Hexachlorobenzene	10
Mercury (¥)	20	Hexachlorobutadiene	55

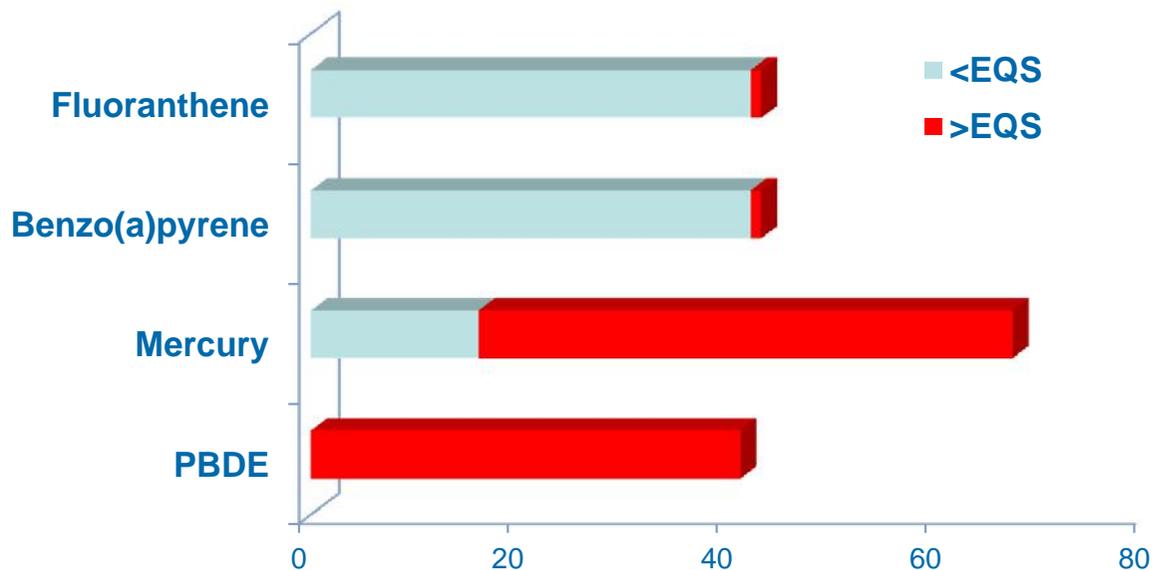
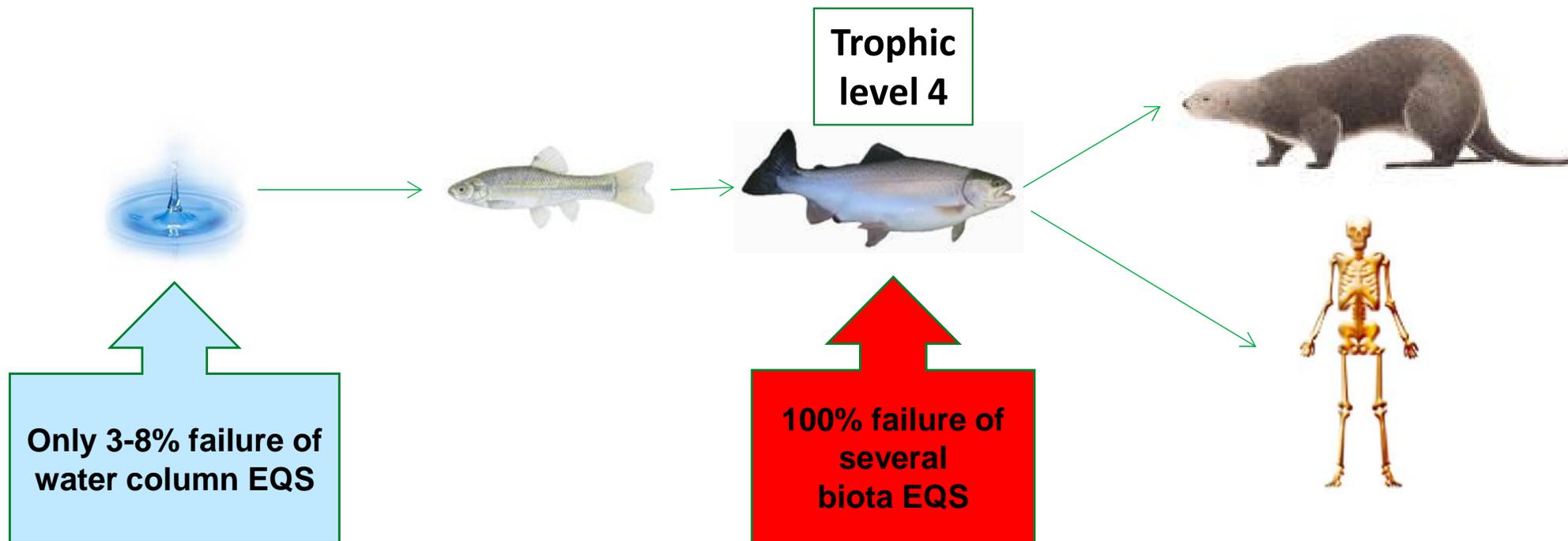
* Marker for 5 PAH (benzo-fluoranthenes, -pyrene, indeno-pyrene)

¥ EU Food Safety Limits (1881/2006/EC) derived from dose/exposure data

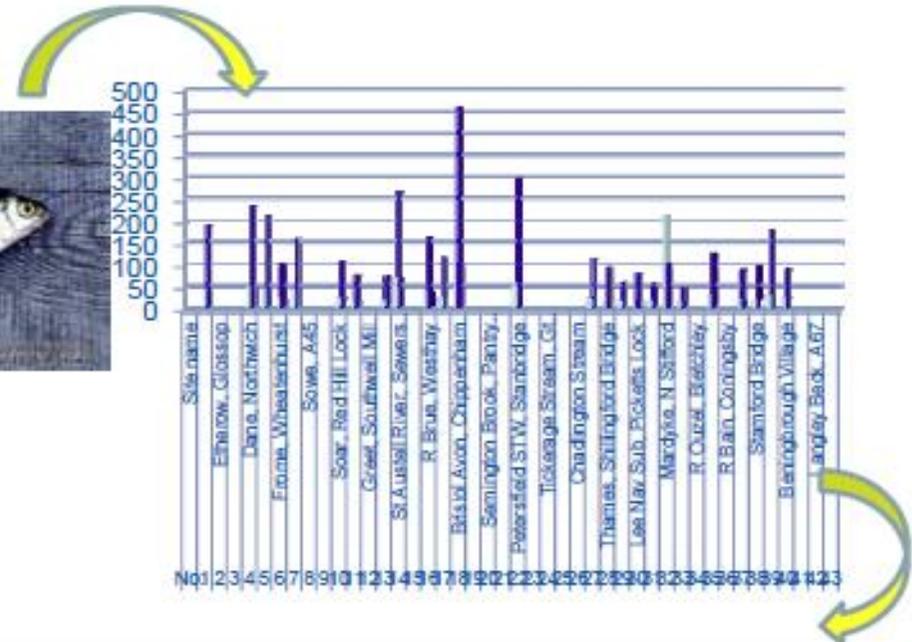
☒ WHO value

Likely to be reviewed & reduced in future following EFSA's opinions.

Why we are concerned with biota-based EQS.

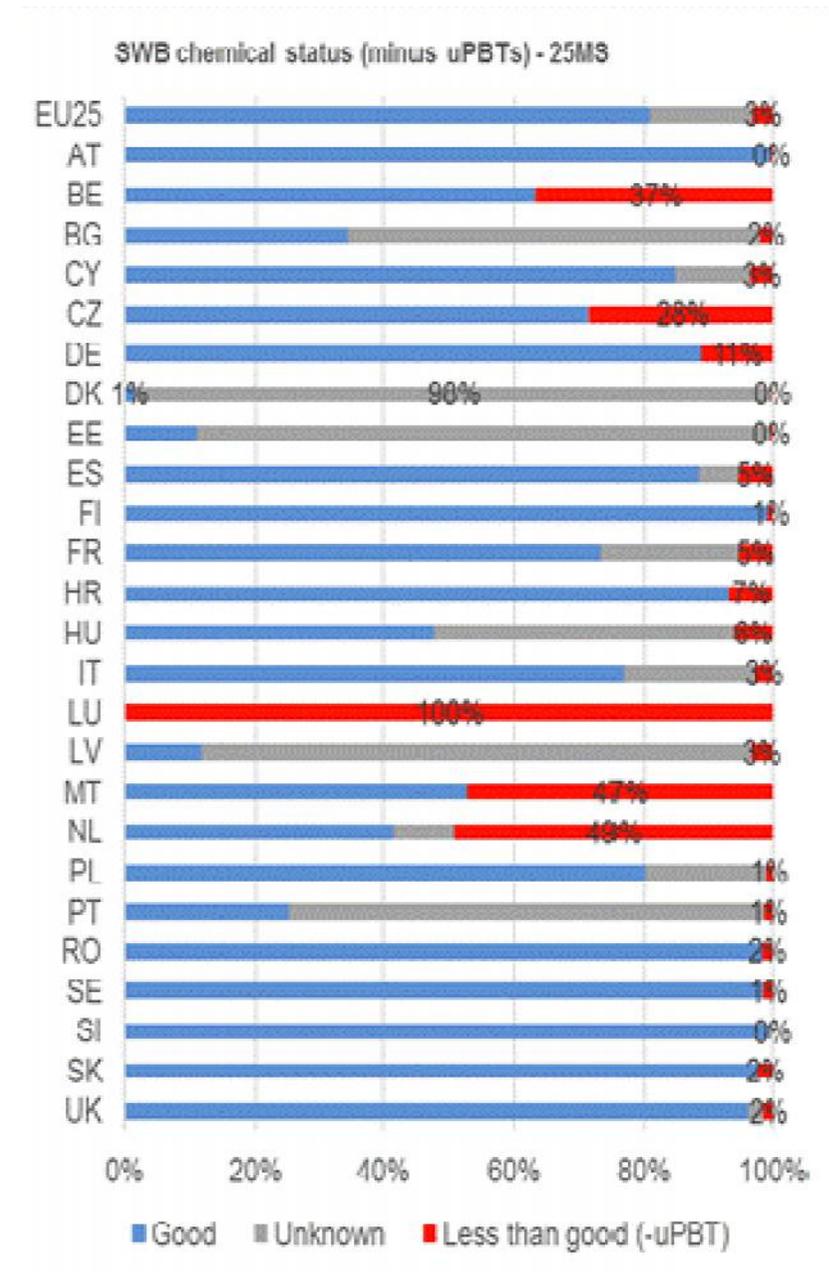
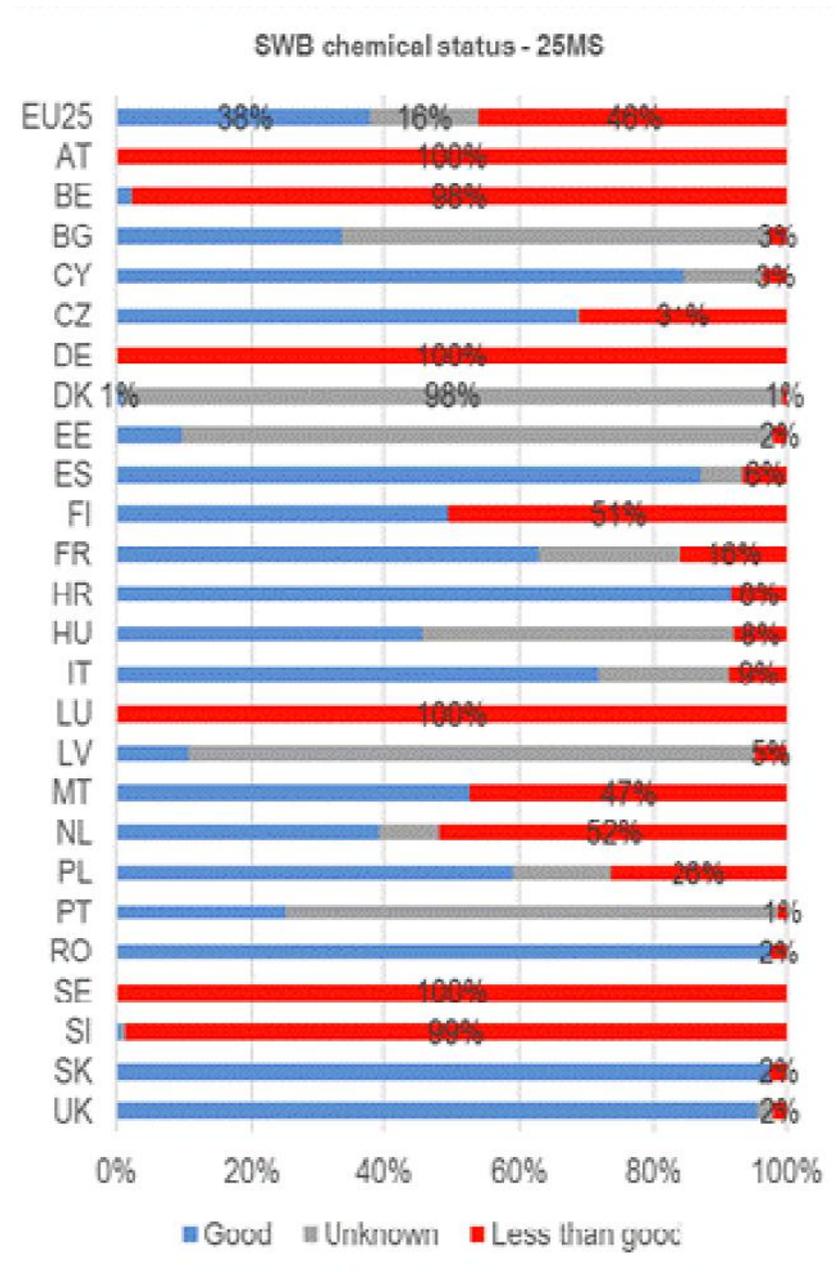


Chemical status of FW sites using EQS[fish] (2015)



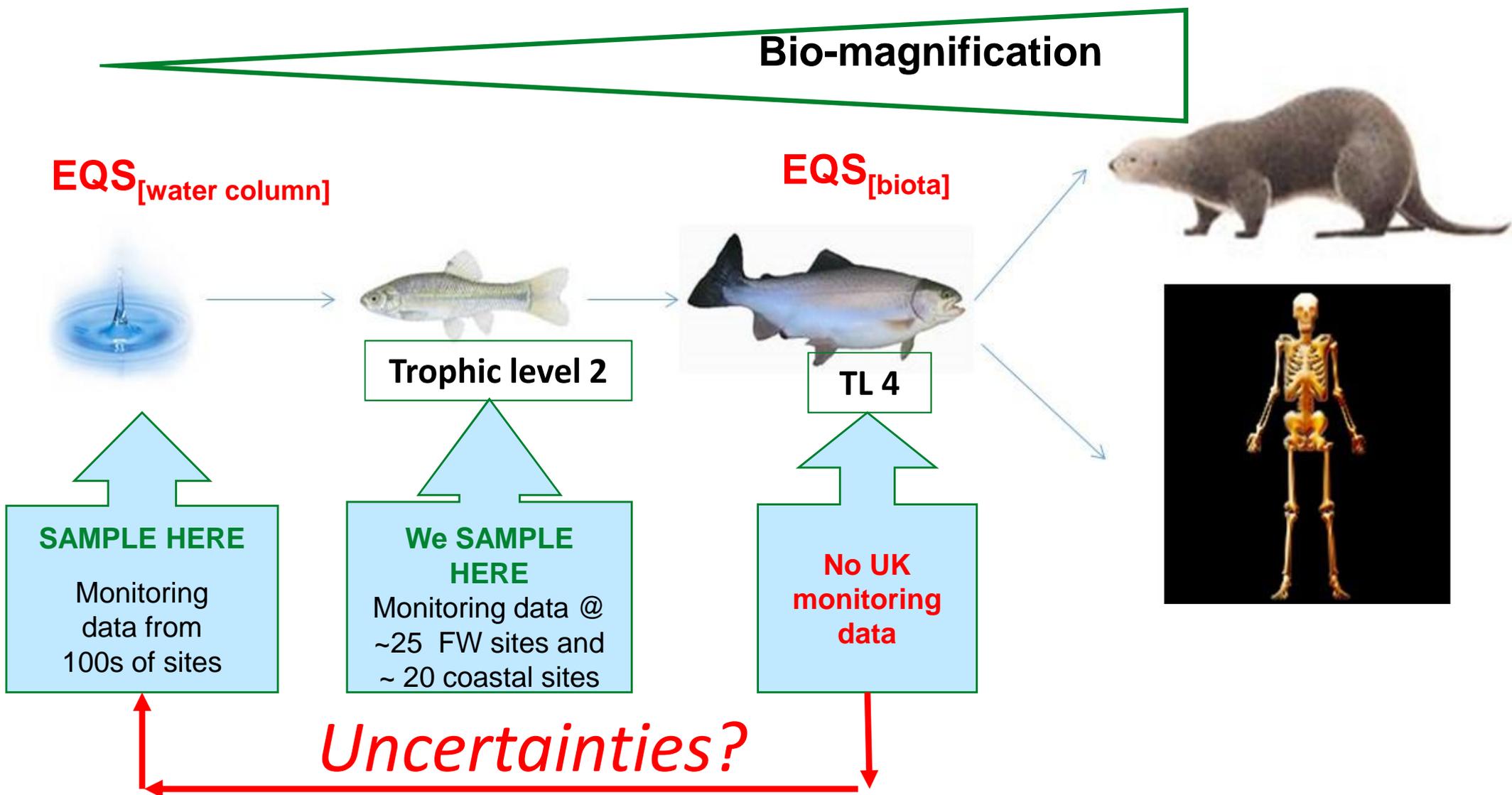
	PBDEs	Hg	HCB	PFOS	BaP	Fluorant here	HCB D	HCB D	Dicofol	Heptachlor + epoxide	Dioxins /Furans /DL-PCBs
No. of sites	31	36	33	10	12	12	33	10	12	29	14
No. sites passing	0	10	33	7	12	12	33	10	12	28	5
No. sites failing	31	26	0	3	0	0	0	0	0	1	9

↑ ↑ ← Biota-based EQS failures → ↑



EEA Report No 7/2018 (2018). European waters. Assessment of status and pressures 2018 (from 2nd RBMPs 2015).

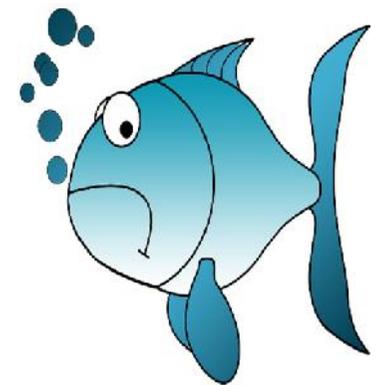
Chemical status & challenges with EQS[biota]



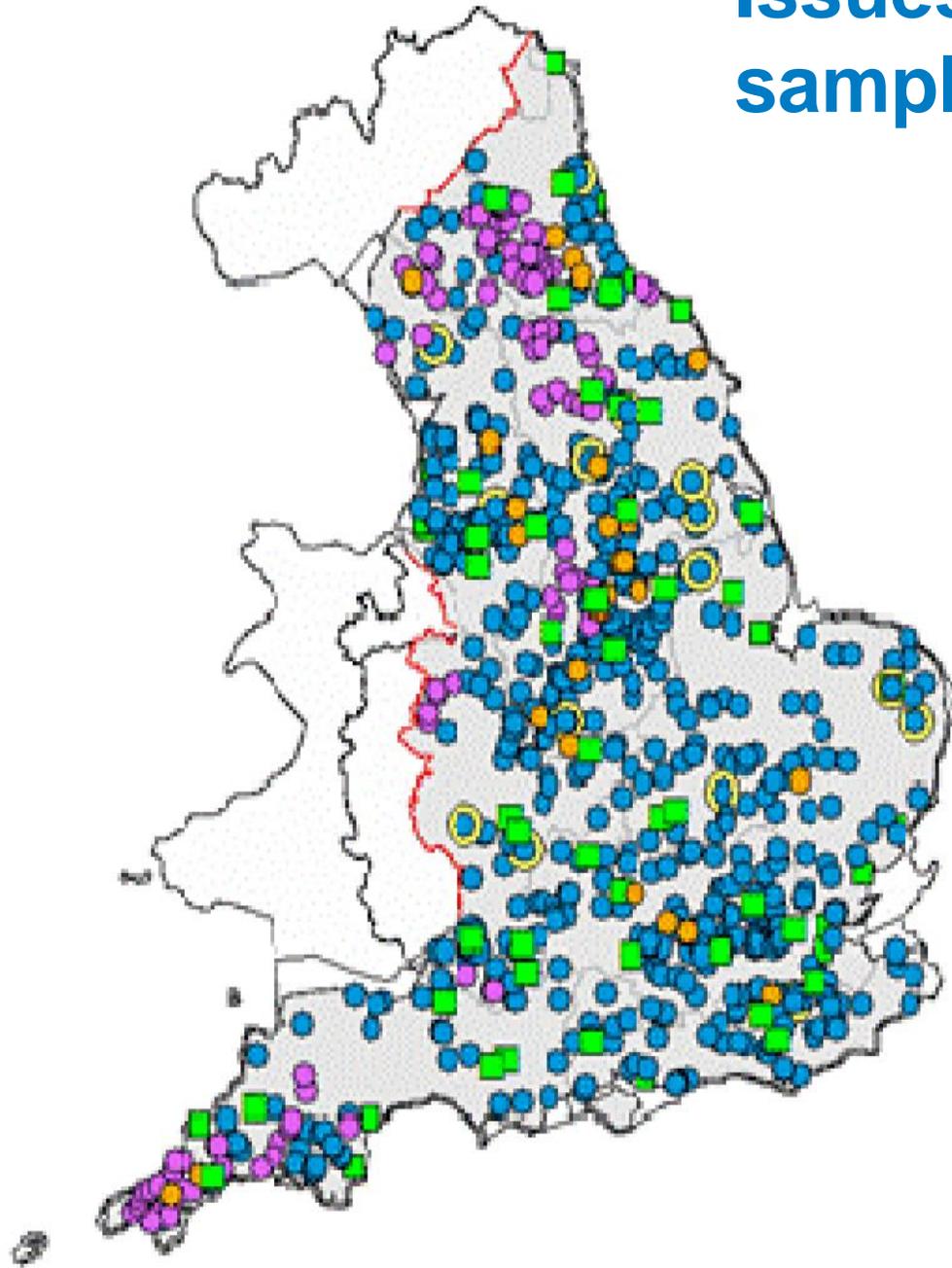
If we have information on a substance's biomagnification, we can **'back-calculate'** a biota EQS to an equivalent water concentration to assess status

Challenges with implementing EQS[biota] in the UK & EU

- **Availability of fish species** – different sampling practices across the EU using different trophic levels & lipid contents.
- **Variability within species** - bioaccumulation can be variable
- **Which part of the fish to sample?** – whole body vs. filet?
- **Adequate replication?** – level of uncertainty of conc. – limits confidence in pass/fail decisions
- **Limited fish monitoring sites**, access to sites & resources to sample
- **Uncertainties in back-calculating** an EQS[biota] to an equivalent water conc.



Issues with surface water & biota sampling locations.



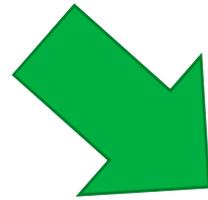
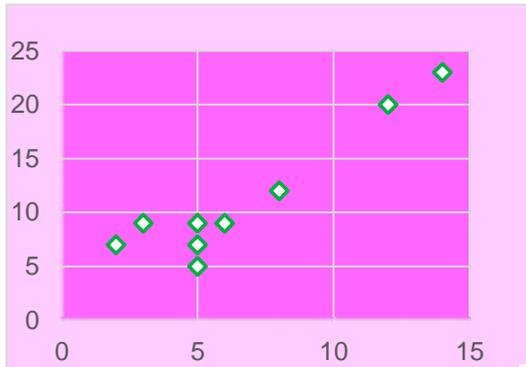
- Biota
- Water
- Water (mines)
- Water (WFD's 'watch list')

- Biota monitoring networks are very patchy, so most waters are unsampled → **no data**
- Cannot legitimately assume that unsampled waters are at good status
- How to interpolate to unsampled waters?
- EA's new strategic monitoring programme

Can we assess chemical status of PBT substances using water concentration data?

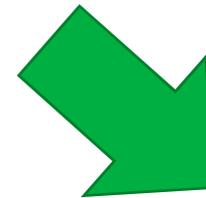
Estimating [biota] from [water] – a possible option

Regression



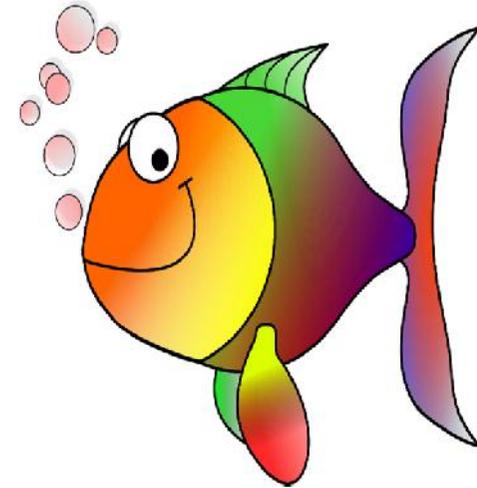
Pass/Fail matrix

		BIOTA	
		P	F
WATER	P	+++++	++
	F	+	+++++



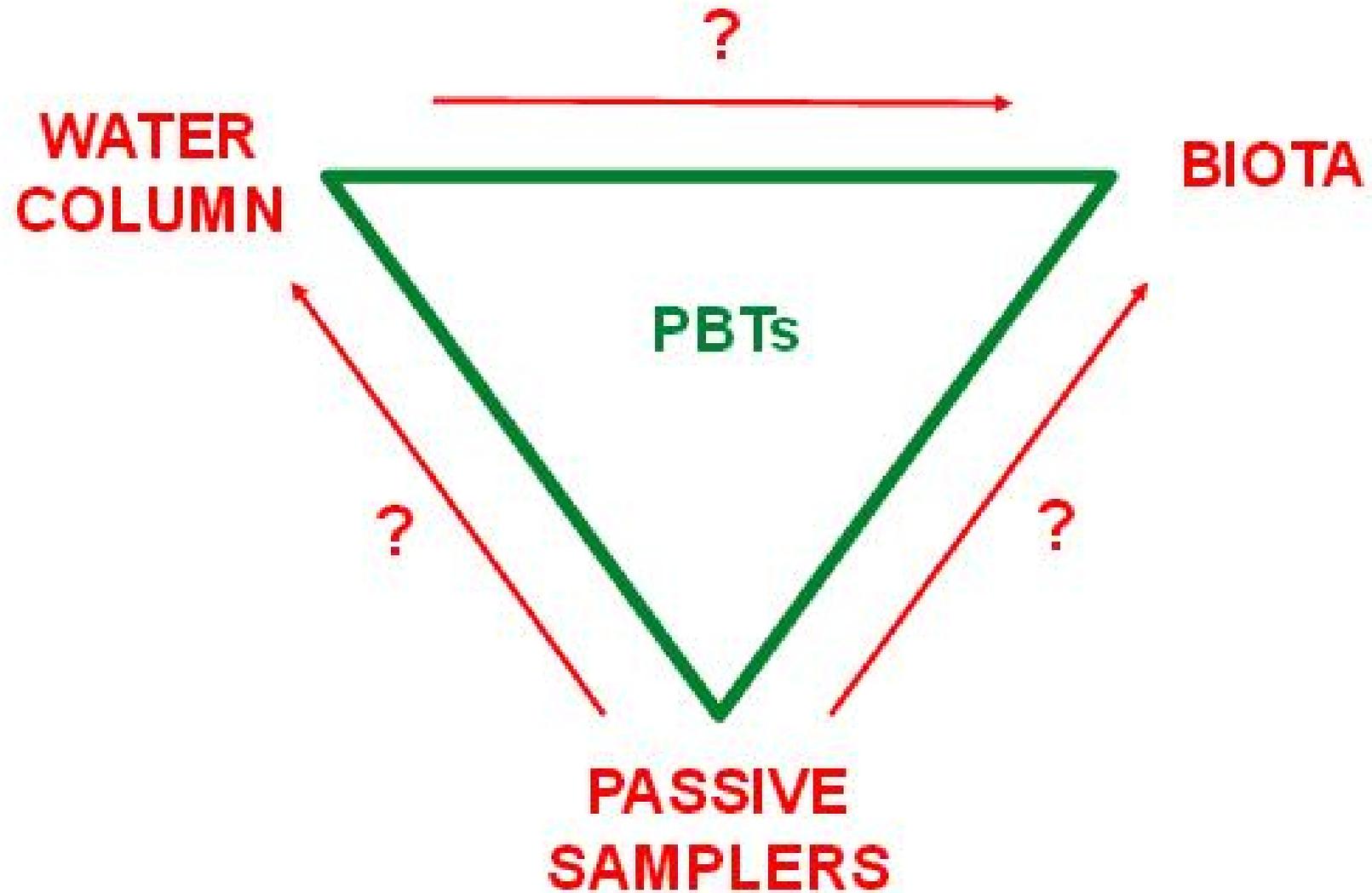
Ranking EQS

Site	Water	Biota
1	Red	Red
2	Red	Red
3	Red	Red
4	Red	Yellow
5	Yellow	Red
6	Yellow	Red
7	Yellow	Yellow
8	Yellow	Yellow
9	Green	Green
10	Green	Yellow
11	Green	Green
12	Green	Green
13	Green	Green



- Very low water concs. – detection issues
- Variable correlations except for PFOS(?)
- Need further studies to validate approach.

The role of passive samplers?



Final remarks for the near future....

- **Implementing WFD – extensive information base & expertise**
- **WFD is “mature” – Reviews of WFD, EQSD & GWD on-going**
- **Revision of EQSD in 2020s. Substances & EQSs added or deselected(?)**
- **Derivation of EQS[biota] for protecting HH needs harmonising with the approach taken for food safety standards**
- **Expect water column (metals) & biota EQS exceedances & chemical status failures for several substances and for a number of decades**
- **Need to better understand how chemicals impact on ecosystem services to better assess the benefits of action on chemicals**
- **The role for Effects-Based Monitoring (EBM) tools to complement chemical (mixtures) status assessment – on-going EU research.**

Thank you for your attention

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