

int₂DBP

H2Oforall and SafeCREW - 'Preparing drinking water supply systems for climate change – case study insights'

An overview of trihalomethane risk in Irish drinking water from peatland dominated catchments

Valerie McCarthy, Dublin City University, Ireland



Funded by
the European Union

Summary of issues related to Disinfection By-products (DBPs) in Ireland

- Approximately 80% of Ireland's drinking water is abstracted from surface water e.g. rivers and lakes.
- Groundwater sources are often influenced by surface water infiltration linked to rainfall events particularly in Karst regions of Ireland.

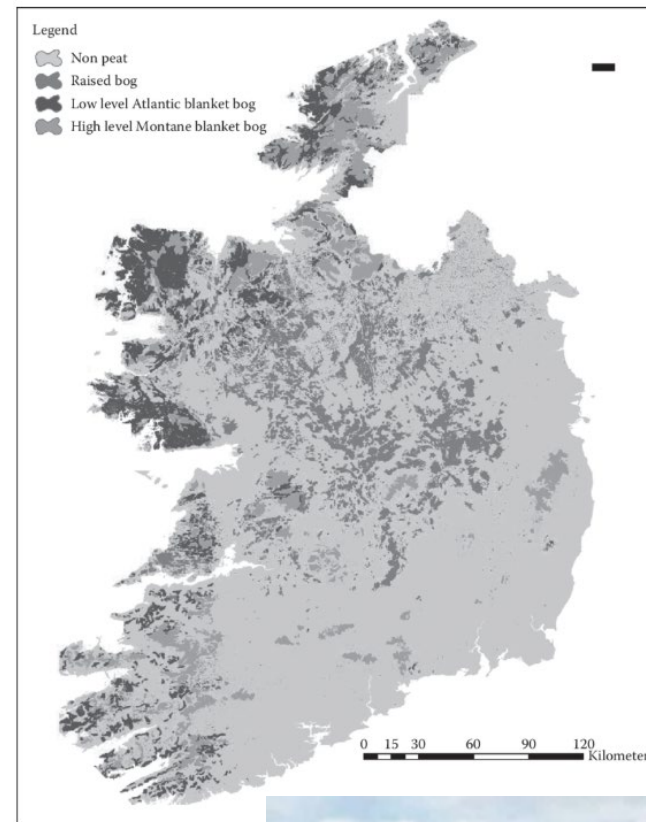


Despite significant resource investment, almost half of all of the surface waters in Ireland are in an **unsatisfactory condition**, achieving less than 'good' status for Water Framework Directive implementation.

Water Treatment - Chlorine is used not only as a primary disinfectant throughout Ireland in water treatment, but additional chlorine can also be added to provide a stable disinfectant residual throughout the widely dispersed distribution network.

Ireland's Peatlands

- In Ireland, 20% of land area is classified as peat which contains more than 75% of the national soil organic carbon.
- Near-intact peatlands actively sequesters carbon; however, only 15% of Irish peatlands are near-intact.
- Following drainage increases of dissolved organic carbon (DOC) fluxes up to 60% have been observed (Evans et al. 2016).

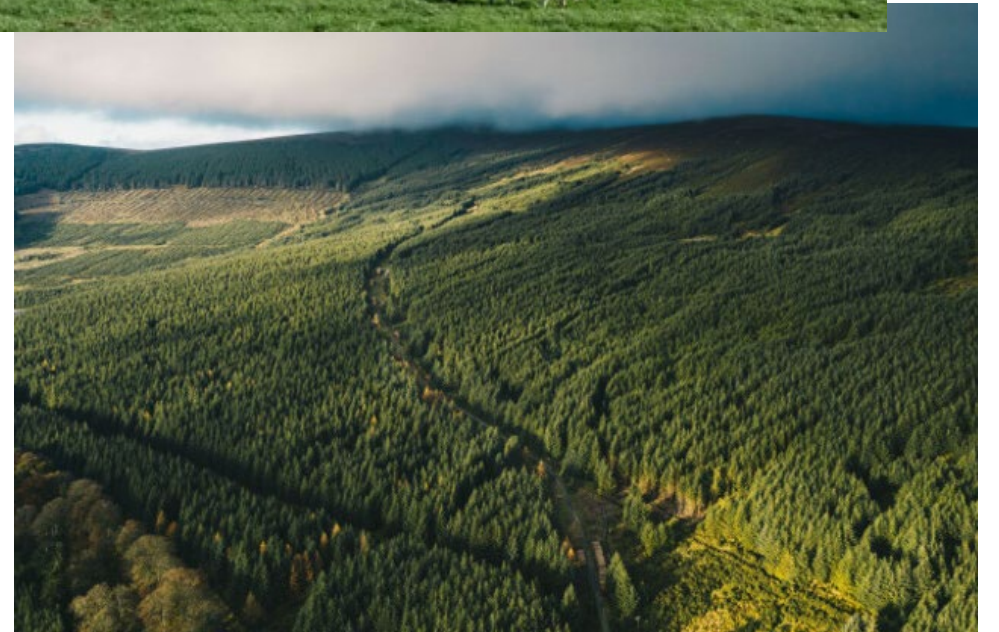


From: Renou-Wilson, Florence & Byrne, Kenneth. (2015).
Irish Peatland Forests: Lessons from the Past and
Pathways to a Sustainable Future.



Other Land-use

- Agriculture accounts for 67% of land-use in Ireland.
- Agriculture can cause nutrient enrichment leading to increased terrestrial derived organic matter in receiving waters.
- Much agriculture in Ireland takes place on peatland soils – using drained and reclaimed peatlands which may no longer be peat-forming but still possesses a peat soil.
- Forestry – located on peatland soils and majority of which are coniferous plantations.

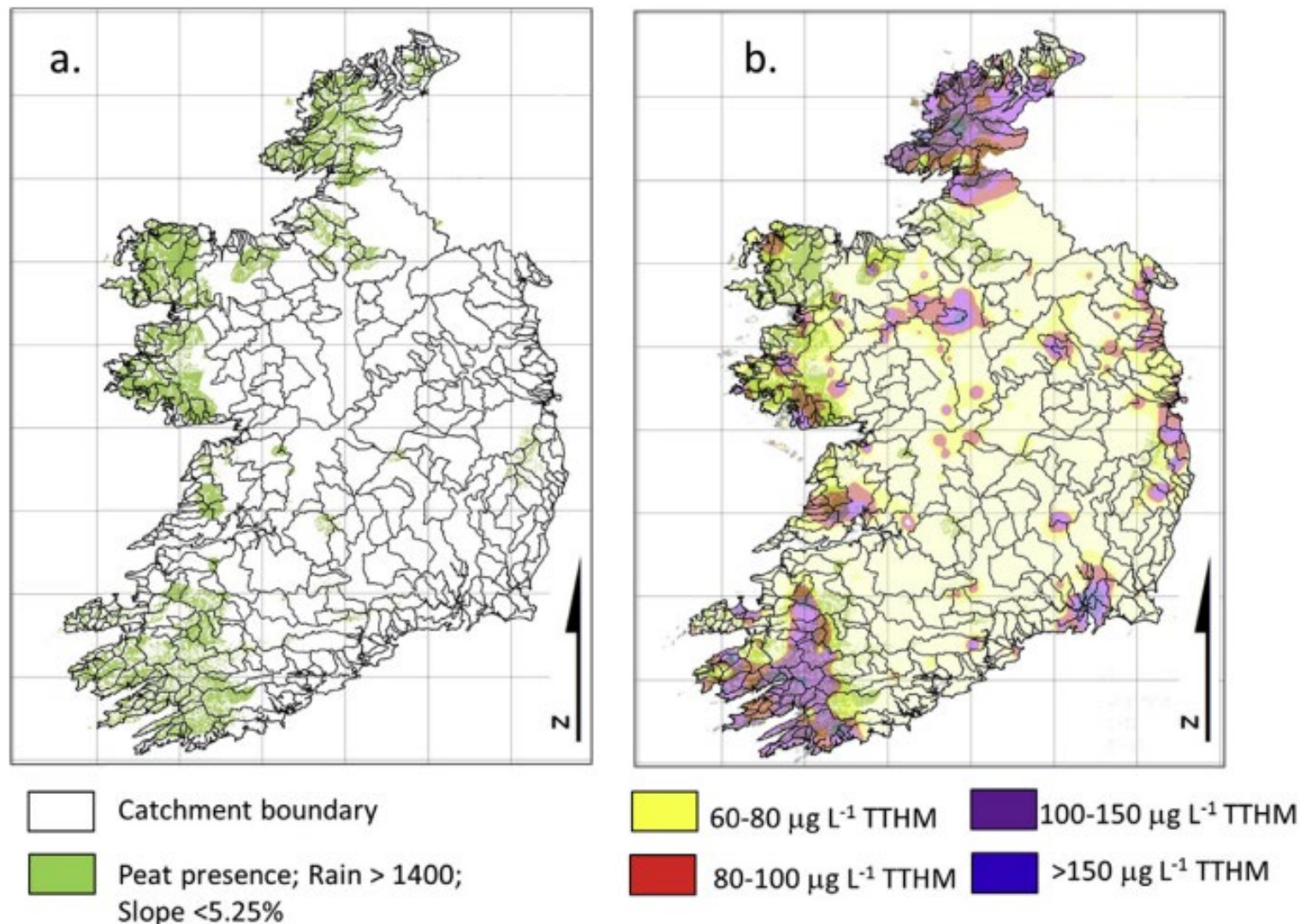


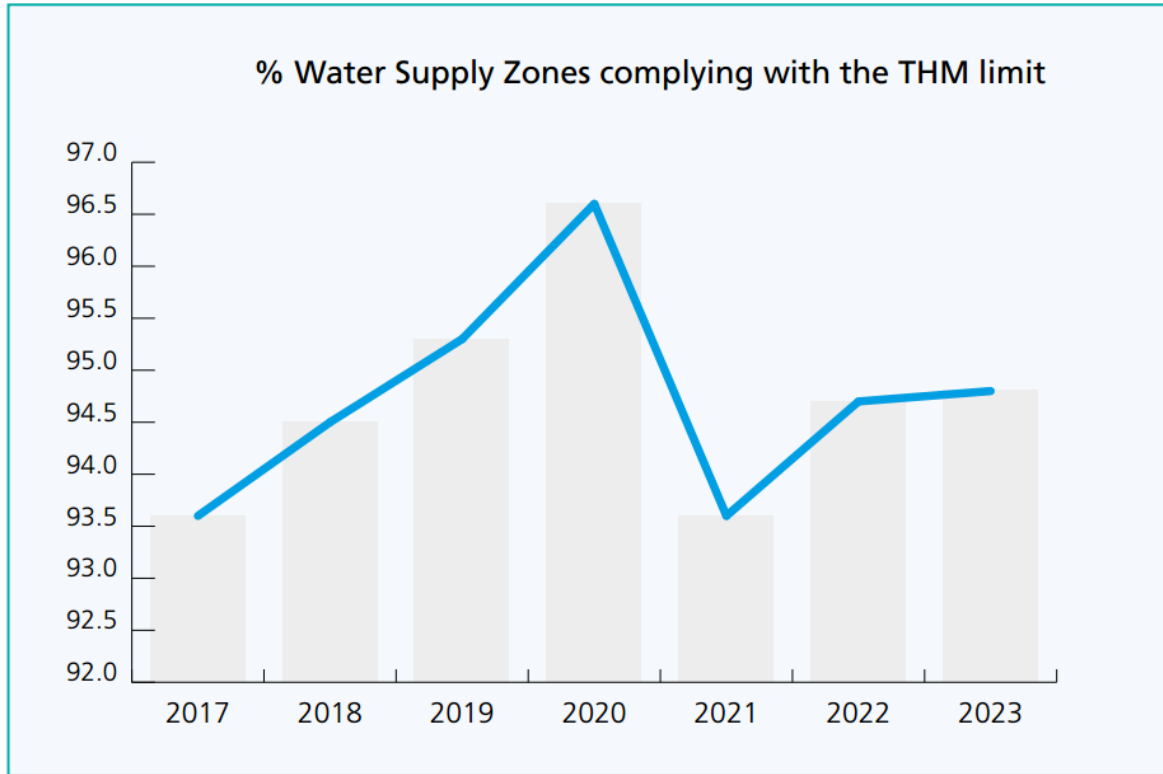
Higher total trihalomethanes (TTHM) concentrations in drinking water in Ireland have been found to be associated with

- Peat presence,
- Shallow topographical slopes (<5.25 %) and
- Higher than average rainfall.

Irish Catchment boundaries showing:

Peat presence, shallow topographical slopes slope <5.25 % and annual rainfall with > 1400 mm (higher than average) correspond with highest TTHM concentration.





EPA drinking water quality in public supplies report (2023)

Since December 2008 a parametric value of **100 µg/l** has been set Total Trihalomethanes (TTHMs) (i.e. a group of four disinfection by-products, namely chloroform, bromoform, dibromochloromethane and bromodichloromethane), for the European Communities (Drinking Water) Directive (98/83/EC) and associated regulations.

- **2015** - The European Commission started infringement proceedings against Ireland for failure to comply with the THM standard in the Drinking Water Directive www.intodbp.eu
- **2020** - The Commission escalated its infringement proceedings against Ireland by issuing a Reasoned Opinion stating Ireland had failed to take the measures necessary to ensure THM compliance in **31** public water supplies and 13 private group water schemes
- **2021** – decline - **58** public supplies failed to meet the standard for THMs, reversing an improving trend on THM compliance since 2017.

National Overview of THM exceedances in drinking water

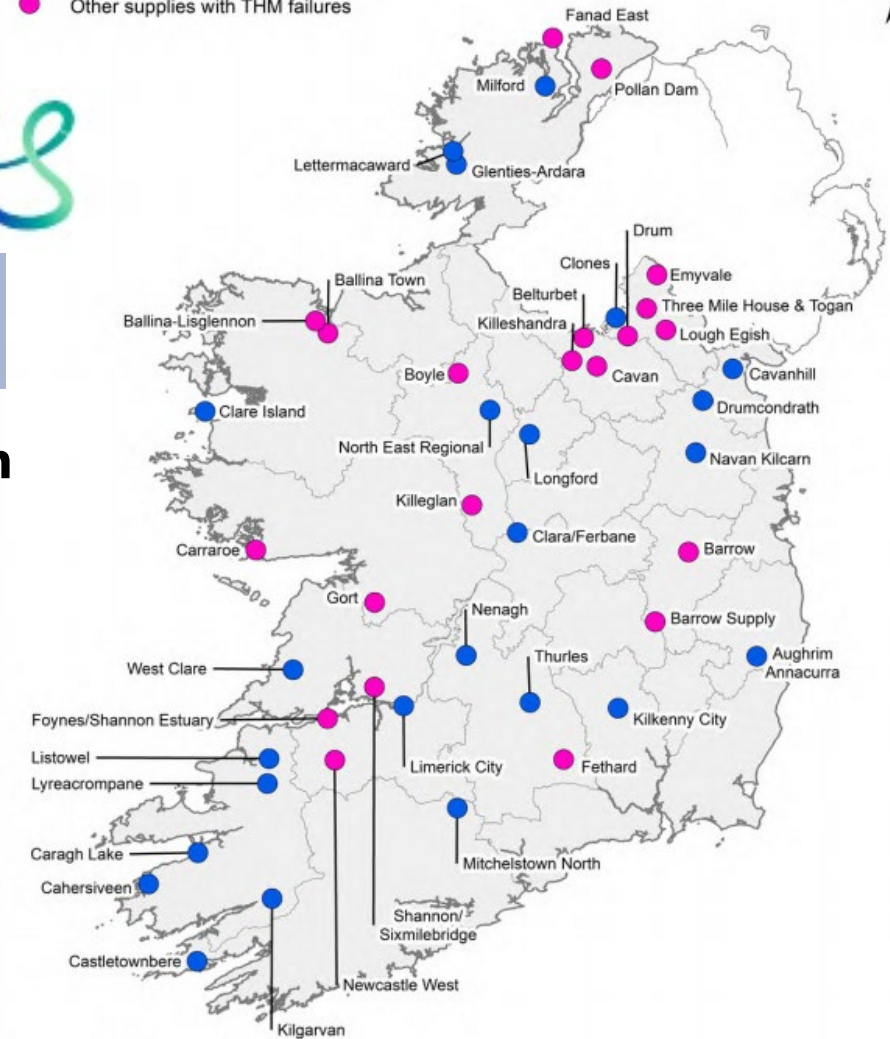


Who is responsible for water supply?

Uisce Éireann, previously known as **Irish Water**, is responsible for secure, safe, and sustainable water services in Ireland.

- Based on the 2023 EPA Drinking Water Quality Report **1 in every 20** public supplies in Ireland failed the THM limit.
- With the number of supplies on the Remedial Action List (RAL) for THMs impacting almost **300,000 people**.
- These figures represents an increase from previous years and not only reflect increased monitoring efforts, but additionally heavier **rainfall events** experienced in the previous four years associated with Climate Change which have increased **levels of organic matter in rivers and lakes in Ireland**.

- Supply on RAL for THM failures
- Other supplies with THM failures

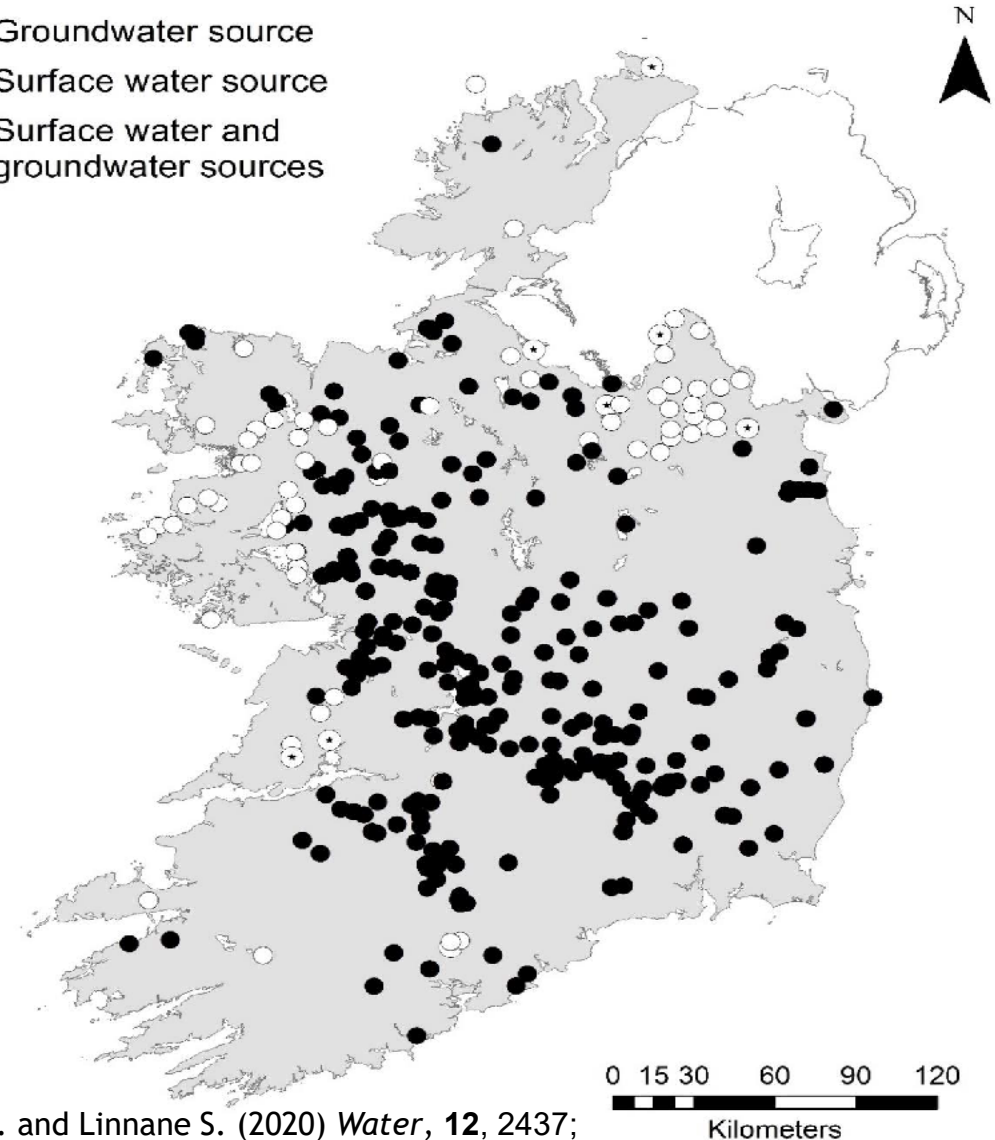


Licence Number CYAL50265032 © Ordnance Survey Ireland/Government of Ireland

Public supplies on RAL for THM or THM failure during 2023. Source: EPA drinking water quality in public supplies report (2023)

- Owing to the large rural population, almost 20% of households have drinking water supplies other than those obtained from public water supplies:
 - Group water schemes set up by volunteer community groups who source, treat and distribute drinking water to their members – these can come from a public or a private supply of water - Approx. 486 schemes across the country.
 - Private individual wells – many of which are not registered with the Local Authority – which means many supplies are unmonitored.

- Groundwater source
- Surface water source
- ⊕ Surface water and groundwater sources



From Rolston A. and Linnane S. (2020) *Water*, 12, 2437;
doi:10.3390/w12092437

Group Water Schemes (GWS) in Ireland

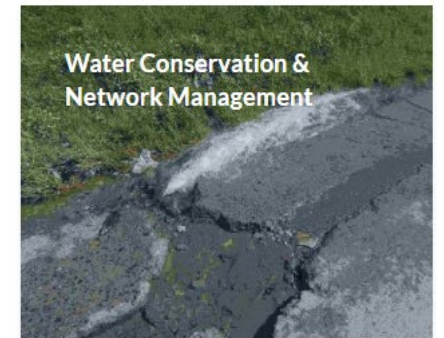


The National Federation of Group Water Schemes is a representative organisation for the community owned group water scheme sector in Ireland.

- Usually, group schemes are established in areas where the local authority does not intend to install a water supply system in the near future, or at all.
- The majority of Group Water Schemes abstracting from surface waters (91%) serve a population of less than 3000 people (Rolston and Linnane, 2020).

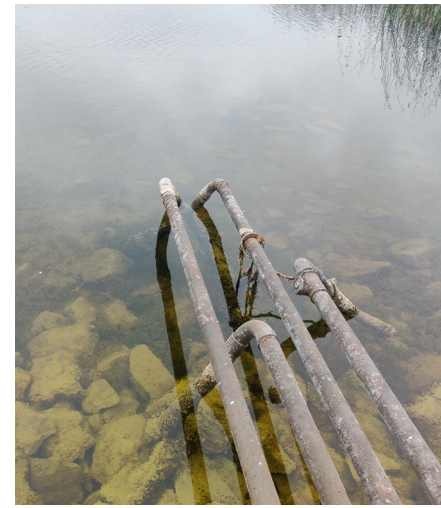
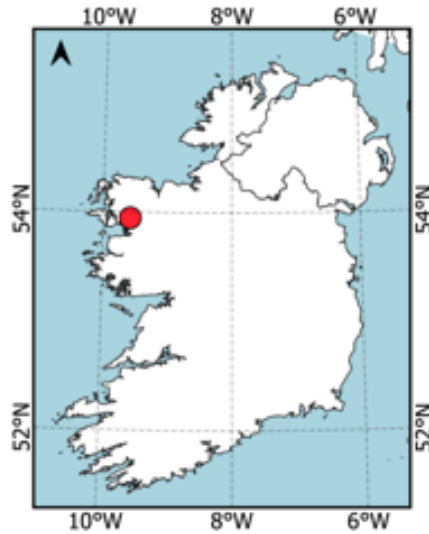


Guidance and Support for GWS

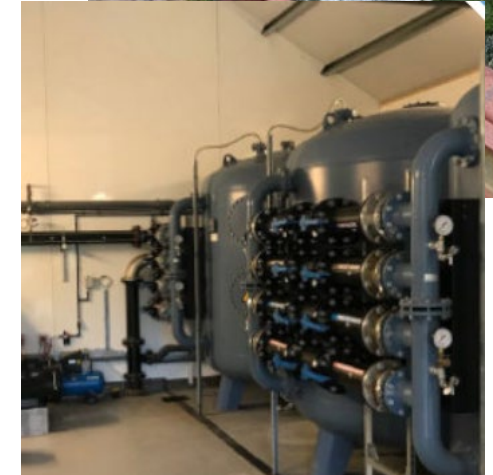


IntoDBP Case Study Sites:

The GWS are a located near to each other in catchments with a high prevalence of peatland:



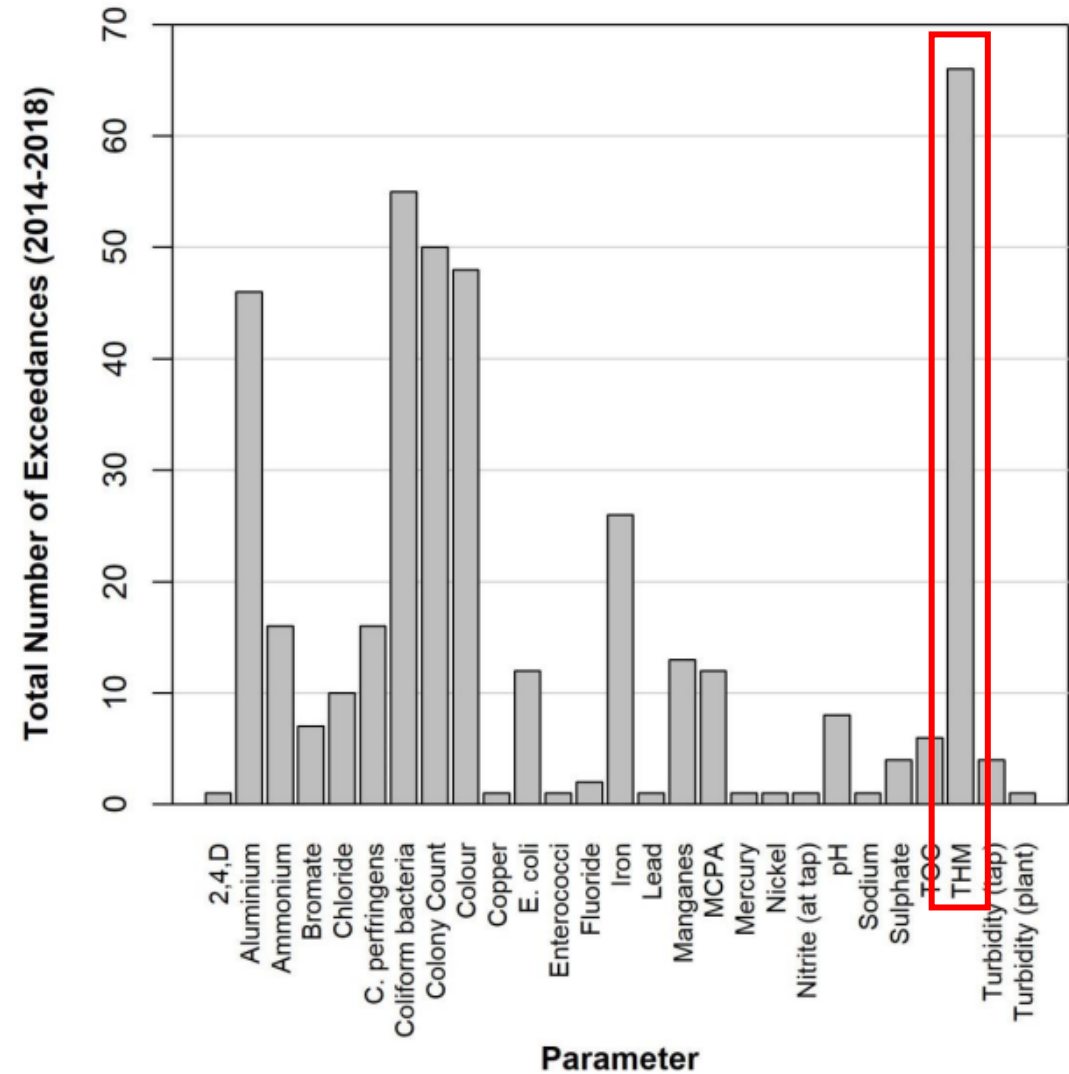
GWS	Water Source	Catchment Size	Principle Land-type	No. of Households	Water Quality	Water Treatment
GWS 1	Lake	6 km ²	Agricultural catchment with forestry	850	Raw water: high colour	Clarification in combination with UV and chlorination
GWS 2	Lake	9 km ²	Agriculture with areas of peat bogs	1460	Raw Water: High Colour	Screening, pressurised sand filtration, UV treatment, chlorination – reservoir with secondary chlorination unit – 220 km of pipeline.
GWS 3	Mountain Stream	1.1 km ²	Heath, peatland	630	Raw Water: high colour, high THM at tap.	Media filtration, ozonation and chlorination.



GWS 1 - highest TOC and highest DBP formation potential – both more than twice over a drinking water guideline value

Considerable amount of organic nitrogen - may lead to the formation of so-called emerging nitrogen containing DBPs like haloacetonitriles, which are not regulated but known for an increased toxicity

In Private GWSs - analysis of treated water exceedances of the 2014 Drinking Water Regulations identified total trihalomethanes (THMs) as the parameter for which exceedances most frequently occurred between 2014 and 2018.

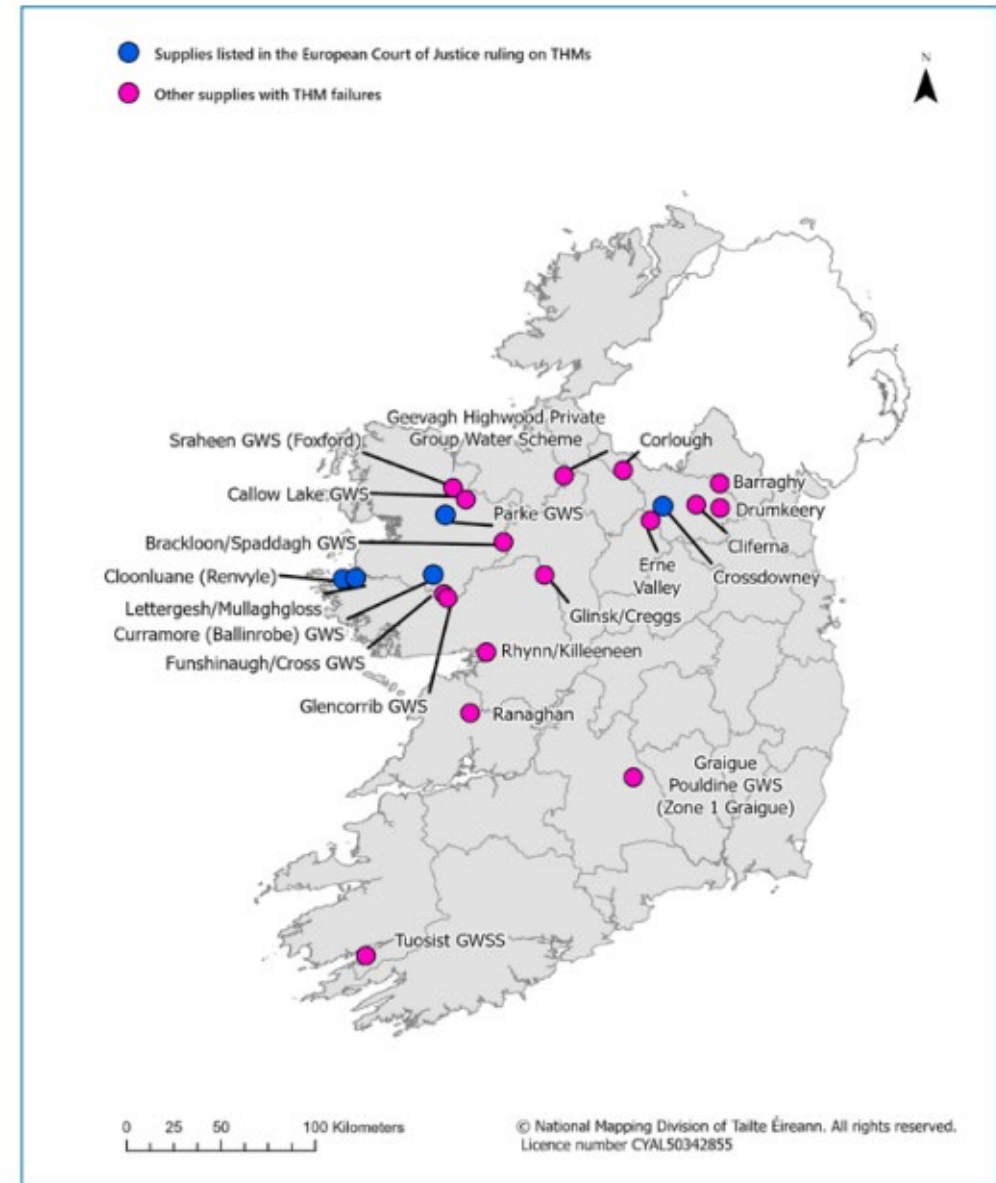


From Rolston A. and Linnane S. (2020) *Water*, 12, 2437; doi:10.3390/w12092437

Overview of THM exceedances in Private Group Schemes

2023 - 21 private group schemes supplying 22,000 people failed the standard for THMs. This is an increase on the 2022 figures – Again heavier rainfall associated with this increase.

2024 - The court of justice of the European union ruled that Ireland had failed to take the measures necessary to ensure THM compliance in **9 Private Group Water Schemes** and failed to give priority to enforcement actions. Five supplies that failed the THM standard in 2023 are listed in the European court ruling.



Private group schemes with THM failures in 2023. Source: EPA ISBN: 978-1-80009-189-4 (2023)

Addressing non-compliance

Examples of work undertaken to resolve THM issues include:

- Construction of new treatment plant/equipment + optimising existing plants – chemical dosing/coagulation etc.
- Replacement of supply source e.g. using groundwater supply instead of surface water supply.
- Protection of **the source of the water supply** from organic and other sources of pollution from agriculture, industry, forestry, peat extraction etc to reduce the level of organic matter to be removed by the water treatment plant.

EPA drinking water quality in public supplies report (2023)



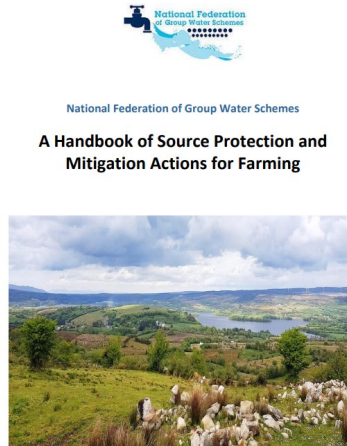
Source: EPA drinking water quality in public supplies report (2023)

Group Water Scheme Sector have been addressed as follows

- Rationalise and upgrade water treatment through a through formalised new relationships with Design, Build, Operate (DBO) water treatment facilities under 20-year contracts.
- However, it became clear that water treatment is not the only issue; **source water quality** affects the cost of water treatment.

Background to Drinking Water Source Protection (SWP)

- Community led approach.
- **'multibarrier approach'**
- By focusing on solutions that address the source of the problem rather than dealing with the consequences (i.e. installing "end of pipe" treatment") – also additional benefits for biodiversity and climate.



Fencing erected as part of source protection works in Irish Group Water Scheme (from: NFGWS -Source-Protection-Phase-II-Report).

- Under the direction of the NFGWS, in the last 15 years, many GWSs have been involved in research on Source Water Protection.



Figure 7 Silt trap installed in stream at Kilberriert

Sediment trap in a small watercourse constructed to protect the Freshwater Pearl Mussel in the River Allow. (Image: Fran Igoo)



A low earthen bund or bank reducing or preventing overland flow entering the watercourse (NFGWS, 2020)

Photos sourced from:
NFGWS, 2020. A Handbook
for Source Protection and
Mitigation Actions for
Farming. Published by the
National Federation of
Group Water Schemes.
Available for download at
www.nfgws.ie

- Many examples in Ireland – various pilot projects and implementation frameworks e.g. – NFGWSs – Handbook of Source Protection and Mitigation Actions for Farming.
- **Difficulty** – little work in SWP has focused explicitly on reducing DOM as a pollutant of concern (focus instead on e.g. nutrient, microbial or pesticide reduction).

- Currently collecting information on a range of Source Protection Measures.
- Working with stakeholders to identify the measures most likely to mitigate against DOM based on this list.
- Understanding Barriers and incidencies – develop a set of recommendations.
- Using of modelling to help predict the effects of climate change and short-term weather on DOC input from the catchment.



Drain on a farm in Ireland with plastic dam was installed – re-wetting agricultural peat land. (Source: FarmPEAT)



A pipe through a peat dam was installed to give flexibility to the farmer if they wished to adjust the water levels within the drain on a farm in Co. Roscommon. (Source: FarmPEAT)



THANK YOU



Valerie McCarthy



valerie.mccarthy@dcu.ie



+353 87 2518530

int  DBP



info@intodbp.eu



www.intodbp.eu



[intoDBP_eu](https://twitter.com/intoDBP_eu)



[intoDBP_eu](https://www.linkedin.com/company/intoDBP_eu)



Funded by
the European Union