

OR/14/047 Summary

From Earthwise

[Jump to navigation](#) [Jump to search](#)

Farr, G, and Hall J. 2014. Atmospheric deposition and groundwater dependent wetlands: implications for effective catchment management and future Water Framework Directive groundwater classification in England and Wales. *British Geological Survey Internal Report*, OR/14/047.

Groundwater Dependent Terrestrial Ecosystems (GWDTEs) are wetlands that critically depend on groundwater flows and/or chemistries (Schutten et al. 2011^[1]) and include statutory (e.g. SSSI/SAC/NNR) and non statutory sites (e.g local nature reserves). There are a wide range of pressures that can lead to unfavourable condition at GWDTEs including: poor management, ineffective grazing regimes, historic and current drainage, and localised agricultural surface runoff. This report will focus upon pressures primarily from atmospheric deposition.

In order for the regulatory and conservation bodies to better protect these sites we need to know more about the relative sources, pathways and fate of atmospheric (and terrestrial) nutrients in GWDTEs. This knowledge base will allow for the design and implementation of successful Water Framework Directive (WFD) program of measures, and catchment management, aimed at reducing significant nutrient damage to GWDTEs, and other conservation/restoration initiatives.

Atmospheric nitrogen exists in oxidized and reduced forms, as wet or dry deposition. Oxidised nitrogen is sourced mainly from fossil fuels with reduced nitrogen (e.g. gaseous ammonia) more commonly associated with agriculture. Regulation of emissions has produced quantifiable reductions of atmospheric emissions (see RoTAP, 2012)^[2] including:

- **decrease in nitrogen oxides (NO_x) emissions of 58% between 1970-2010**
- **decrease of ammonia (NH₃) emissions of 21% between 1990-2010**

Point sources such as factories are arguably easier to regulate than diffuse sources of atmospheric pollution, such as agriculture. These difficulties are reflected in data from RoTAP, (2012)^[2] showing that, although there has been a reduction in some emissions that there has been:

- **little change in concentrations of reduced nitrogen (as ammonia) deposition since 1990**
- **no change in total deposition of nitrogen (350-400kt-N per year) over the last 20 years**

Atmospheric deposition is mapped on a 5 x 5 km grid scale for the UK using the CBED (concentration based estimated deposition) methodology; this allows every part of the UK to be assigned a figure for atmospheric deposition. The majority of SSSIs making up the GWDTEs in this study have been assigned a Critical Load value (in kg N ha⁻¹ year⁻¹) to one or more habitat features, thus allowing the excess deposition above the critical load (i.e the exceedance) to be calculated.

Analysis shows that:

- **Critical loads can be applied to one or more feature habitats of 2355 of the 3320 GWDTEs in this study**
- **Nitrogen deposition exceeds the critical loads for at least one habitat feature of 64% of the GWDTEs included within this study. However 965 sites in this analysis have no**

critical load, thus

The Water Framework Directive classification requires a series of tests to be applied to each groundwater body in order to classify it in either 'poor' or 'good' status. One of these tests is the 'Groundwater Dependent Terrestrial Ecosystem Test' that uses the recently defined 'Threshold Values' for groundwater nitrate (UKTAG, 2012a)^[3] in conjunction with ecological evidence to classify each GWDTE. The most recent cycle of WFD classification suggests that:

- **6 groundwater bodies are classified as 'Poor Status' due to nutrient pressures. This number is likely to rise in the future as more data becomes available**
- **65 groundwater bodies are considered probably at risk due to nutrient pressures on a GWDTE**

The first comparison of Critical Loads and Threshold Values suggests the following:

England and Wales

- 64% GWDTEs exceed their Critical Load (atmospheric) for one or more habitat features.** This figure is lower than expected as there are 865 sites with no critical load included within the dataset
- 3% GWDTEs exceed their Threshold Value (groundwater)**
- 3% GWDTEs exceeded both the Critical Load and Threshold Value**

The analysis shows that nitrogen deposition exceeds the critical loads for at least one feature habitat for 90% of the GWDTEs (SSSIs) to which critical loads could be assigned, whilst a much smaller number exceed their groundwater Threshold Value. **However the Threshold Value results should be treated with caution** for two reasons;

- **it is likely that as more groundwater chemistry data is collected, that an increasing (although unknown) number of GWDTEs may exceed their threshold values, thus potentially failing the next WFD classification as many GWDTEs are also at risk from localised nutrient rich surface runoff and groundwater derived from agricultural processes**
- **as more data and knowledge is gathered then it is possible that the existing nitrate threshold values (UKTAG, 2012a)^[3] may be refined and lowered and for specific sites this could result in a higher number of exceedances**

The 65 groundwater bodies currently at risk due to nutrient pressures at GWDTEs may be the most likely candidates to fail future classifications as more data is collected.

This analysis has implications for future WFD classification as it has become clear that there is still significant ambiguity as to the dominant sources and pathways (source attribution) for nutrients entering GWDTEs. This uncertainty has a direct effect on the regulatory bodies as it makes it more challenging to understand which actions to take to successfully eliminate or mitigate against these pressures.

- **There is a need for the collection of more water quality data at/or in WFD monitoring points considered to be hydrologically linked to GWDTEs. This would provide vital data for the future WFD classification of GWDTEs in England and Wales against existing threshold values**
- **Nitrogen deposition exceeds the critical loads for one or more feature habitats of 64% of sites classed as GWDTE within this study, suggesting that effective catchment management must be considered together with the regulation of emissions from**

industry and agriculture to help GWDTEs achieve favourable status

Assessing the sources and pathways of nutrients at GWDTEs (source apportionment) is a critical part of the solution to better understanding, management and protection of GWDTEs. There are however numerous shortfalls in our understanding that limit our ability to assess the impact on the receptors, namely the vegetation at GWDTEs. Knowledge gaps (see Emmett et al. 2011)^[4] include;

- **poor understanding of time scale response of ecology to background N deposition**
- **long term and historic monitoring data are rare, thus we do not know how many habitats have changed already.**
- **difficulty of separating the effects of other sources of nutrient input (e.g surface water runoff, and groundwater and surface water inputs) from atmospheric deposition-source apportionment**
- **The combined nitrogen load from groundwater and atmospheric sources may exceed biological thresholds even where separately the critical load or GWDTE threshold are not exceeded**

To address these issues it is proposed that a selection of GWDTEs in England and Wales will be selected for further study. The aim of this new study will be to undertake source attribution and loading for nutrients for both terrestrial and atmospheric sources, to directly inform the WFD program of measures, effective catchment management and site restoration/conservation programs.

Sites will be chosen based on the current pressures from atmospheric and terrestrial nitrate and habitat condition. Traditional and novel techniques will be used to attribute nutrients to their sources. It should be noted that by the term 'source apportionment' we are hoping to define the relative sources of pollution e.g. agriculture 60%, road traffic 40% and we are NOT trying to identify specific locations, e.g. Mr Smiths Farm. Existing Environment Agency nitrate loading tools will be used to model potential loading within groundwater catchments of GWDTEs. Only sites with pre-existing conceptual models and monitoring networks will be chosen as this will reduce cost and improve understanding. A multi agency expert working group will be formed to plan and oversee any future work.

References

1. ↑ SCHUTTEN, J, VERWEIJ, W, HALL, A, and SCHEIDLEDER, A. 2011. Common Implementation strategy for the Water Framework Directive (2000/60/EC). Technical report No. 6. *Technical report on Groundwater Dependent terrestrial Ecosystems*. ISBN: 978-92-79-21692-3
2. ↑ ^{2.0} ^{2.1} RoTAP, 2012. Review of transboundary Air Pollution: Acidification, Eutrophication, Ground Level Ozone and Heavy Metals in the UK. Contract Report to the Department for Environment, Food and Rural Affairs. *Center for Ecology & Hydrology*.
3. ↑ ^{3.0} ^{3.1} UKTAG, 2012a. *Technical report on groundwater dependent terrestrial ecosystem (GWDTE) threshold values*. Version 8 March 2012.
<http://www.wfduk.org/resources%20/groundwater-dependent-terrestrial-ecosystem-threshold-values>
4. ↑ EMMET, B A, ROWE, E C, STEVENS, C J, GOWING, D J, HENRYS, P A, MASKELL, L C, and SMART, S M. 2011. Interpretation of evidence of nitrogen impacts on vitiation in relation to UK biodiversity objectives. *JNCC Report No. 449*.

Retrieved from 'http://earthwise.bgs.ac.uk/index.php?title=OR/14/047_Summary&oldid=52265'
[Category:](#)

- [OR/14/047 Atmospheric deposition at groundwater dependent wetlands: implications for effective catchment management and Water Framework Directive groundwater classification in England and Wales](#)

Navigation menu

Personal tools

- Not logged in
- [Talk](#)
- [Contributions](#)
- [Log in](#)
- [Request account](#)

Namespaces

- [Page](#)
- [Discussion](#)

Variants

Views

- [Read](#)
- [Edit](#)
- [View history](#)
- [PDF Export](#)

More

Search

Navigation

- [Main page](#)
- [Recent changes](#)
- [Random page](#)
- [Help about MediaWiki](#)

Tools

- [What links here](#)
- [Related changes](#)
- [Special pages](#)
- [Permanent link](#)
- [Page information](#)
- [Cite this page](#)
- [Browse properties](#)

• This page was last modified on 26 July 2021, at 14:58.

- [Privacy policy](#)
- [About Earthwise](#)
- [Disclaimers](#)

