Supporting document

Groundwater Draft Classification Methodology: Surface Water Chemical Test 2020/2021

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Groundwater Draft Classification Methodology: Surface Water Chemical Test

Introduction

All groundwater bodies in Northern Ireland were classified in 2020 to establish whether they are at 'good' or 'poor' status utilising monitoring data from the past six years (January 2014 – December 2019). Status is divided into qualitative and quantitative status and a number of tests were carried out for each, see Figure 1.

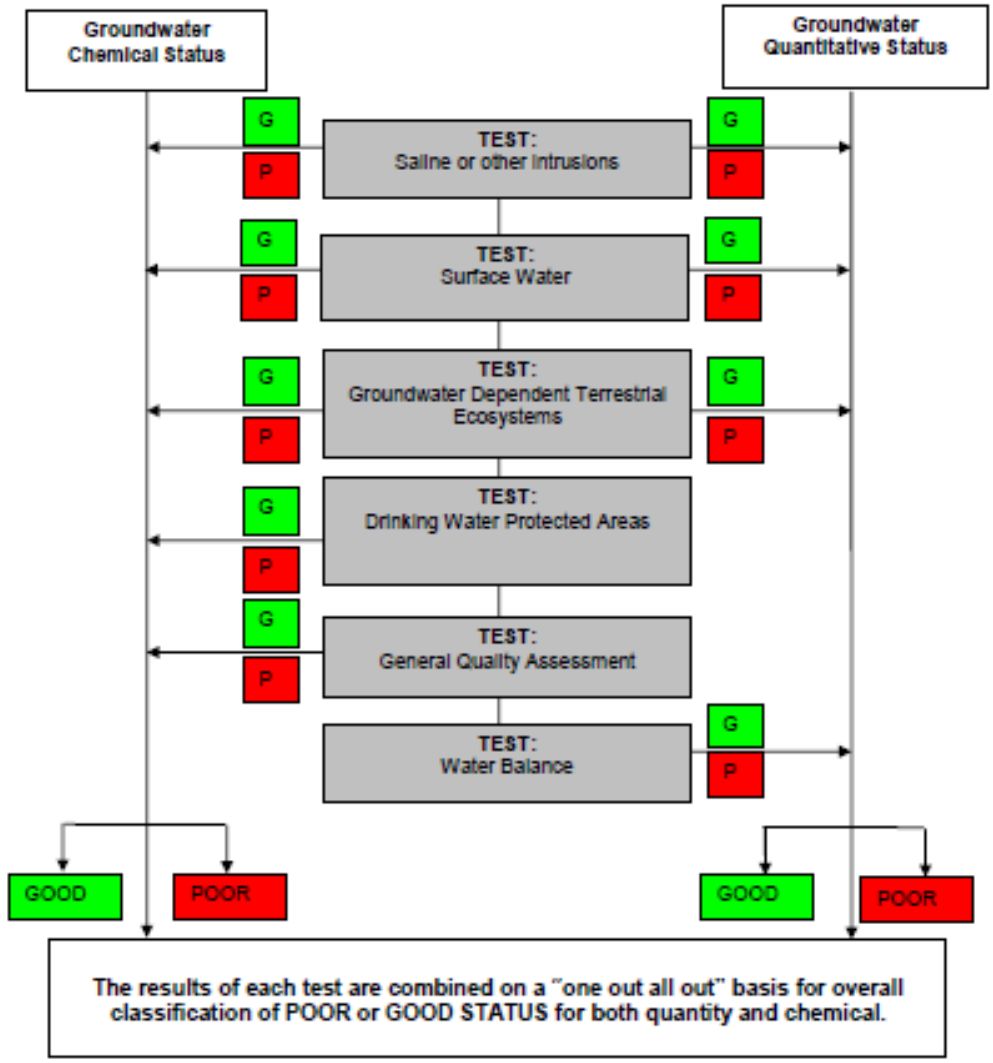

Figure 1: Overview of classification tests [from UK Technical Advisory Group paper 11b(i)].

Surface Water Chemical Classification

Surface Water Chemical classification (also known as surface water qualitative) checks whether chemicals, namely phosphorus, contained in the groundwater baseflow (to the surface water body) contribute to status failure of that surface water body.

The purpose of this test is to determine if groundwater is a significant pathway for pollutants being transported to surface water bodies resulting in a less than good status assessment of a surface water body. Application of generic measures to a catchment may not adequately deal with the source if groundwater is a pathway of pollutants into a river. This test can be applied to any physico-quality determinands likely to be of relevance to groundwater. For the purposes of the classification method, only phosphorus will be assessed.

This method is derived from the UKTAG guidance for chemical classification, updated for the second RBP cycle (UKTAG, 2012).

Note: This test method uses data from surface water monitoring points rather than the combined result for a surface water body. It is more accurate to apply this test in this way since monitoring points can be better attributed to contributing groundwater bodies.

1. Identify surface water monitoring points classed as being at less than 'good' status based on draft classification 2020.

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2. Identify which groundwater body or bodies a monitoring point is hydraulically connected with.

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3. Identify representative groundwater monitoring points within 10 km of each surface water monitoring point that are also within the same groundwater body identified in step 2. If no representative monitoring points can be found, go to step 8.

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4. Does the mean of the last six years phosphate data exceed the calculated threshold value?

Threshold Value = 0.5 x (Relevant new EQS)/Average BFI for SWB

If no go to step 8. If yes continue to step 5

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5. Calculate the annual loading of phosphate entering surface water from groundwater as base flow.

SW Body area x Eff. Rainfall x BFI x GW mean conc. of P

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6. Calculate the annual load of phosphate in a surface water body required at a surface water monitoring point to exceed the relevant EQS.

Annual influenced flow volume x Relevant EQS

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7. Is the loading of phosphate entering a surface water body from groundwater greater than 50 % of the total annual load of phosphate in a surface water? If yes, then characterise groundwater body as 'poor' status.

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8. For all groundwater bodies identified in step 2 with no representative monitoring points, the groundwater body is at 'good' status.

Threshold values

New threshold values for classification were introduced by UK Technical Advisory Group who consulted on them in 2012. Threshold values used for classification can also be found in the Groundwater (Amendment) Regulations (Northern Ireland) 2014.

Test	New threshold
Impact of groundwater quality on chemical status of surface water body	$\frac{1}{2} \cdot \frac{\text{surface water standard}}{\text{dilution factor}} =$ $\frac{1}{2} \cdot \frac{\text{EQS}}{\text{BFI}}$

Surface Water Body Assessment

There are 450 freshwater river waterbodies (SWBs) defined across Northern Ireland. Each of these is assessed for various physico-quality determinands for which Environmental Quality Standards have been derived, including phosphorus.

Phosphorus is a nutrient released from diffuse pollutant sources. It is not as soluble as nitrogen and is leached at a slower rate from soil than nitrogen. Along with nitrates, phosphates are an important nutrient in aquatic ecosystems. Increased concentrations of both nitrates and phosphates can lead to the accelerate growth of algae and other plants.

Environmental Quality Standards (EQS) were set in 2006 by the UKTAG (UKTAG, 2006) as a method for assessing what the phosphorus concentration would need to reduce down to in a surface water body that was already ecologically affected. For the new River Basin Planning cycle new phosphorus (P) standards (EQS) have been agreed which are more stringent.

Monitoring Data

Groundwater quality in Northern Ireland is measured through the collection of water samples from boreholes and springs that are mostly owned and operated by third parties. Hence NIEA rely on the co-operation of land/ property owners to continue sampling from their groundwater sources for the chemical monitoring. This means that the network can change due to businesses closing or changing their groundwater usage and datasets for trend assessments are often small. The network consists mainly of industrial boreholes where groundwater is utilised for manufacturing or food/ drinks production. A small number of springs or boreholes

purpose-installed by NIEA, which are purged prior to sampling, are also monitored. Regional monitoring of groundwater across Northern Ireland began in 2000. The location of the stations can be viewed on the River Basin Plan Map Viewer. The monitoring frequency and selection of determinands follows UKTAG guidance. Each station monitored was analysed twice a year for phosphorus.

Surface Water Environmental Quality Standards

The following are the existing standards used for phosphorus (From UKTAG, 2008).

Type	Annual Mean of reactive phosphorus (µg/l)
Lowland , low alkalinity (1n)	50
Upland, low alkalinity (2n)	40
Lowland , high alkalinity(3n)	120
Upland, high alkalinity(4n)	120

The new standards are bespoke to each monitoring point. They are calculated using the following method which can be viewed in UKTAG (2013).

Standard = 10^((1.0497 x log10 (EQR)+1.066) x (log10 (reference condition RP)-log10(3,500)) + log10(3,500))

EQR means ecological quality ratio. Depending on the status class this value changes. High = 0.702, Good = 0.532, Moderate = 0.356, Poor = 0.166.

Reference Condition RP means the reactive phosphorus concentration at near neutral conditions. It is estimated using this equation.

Reference condition RP = 10^(0.454 (log10alk) – 0.0018 (altitude) + 0.476)

Alk = alkalinity, the concentration of CaCO3 in mg/l. For sites with an alkalinity greater than 250, alkalinity is set to 250. For sites with an alkalinity less than 2, it is set to 2.

Altitude = site's altitude above mean sea level in metres. For sites with an altitude greater than 355 metres, altitude is set to 355 metres.

References

UKTAG Paper 11b(ii), (2012). Groundwater Quantitative Classification for the purposes of the Water Framework Directive. www.wfduk.org

UKTAG Paper, (2008). UK Environmental Standards and Conditions (Phase1). www.wfduk.org

UKTAG Paper, (2013). Updated Recommendations on Phosphorus Standards for Rivers. www.wfduk.org

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