

Review Process of WFD: Expert consultations **Statement on Groundwater Ecosystems and Riverbed** **Colmation**

Société Internationale de Biospéologie (SIBIOS) / International Society for Subterranean Biology (ISSB)

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1.) General Remarks

The high standards of the EU Water Framework Directive (EC-WFD) have to be maintained. Their implementation has to be improved and new scientific knowledge and data must be regarded.

The focus of this paper is to make recommendations for the implementation of new indicators for groundwater/groundwater ecosystems of all aquifer types and for riverbed colmation. These indicators described below should be added to the minimum list of parameters to Annex IIb of the Groundwater Directive (EC-GWD) as a technical adaptation and to the Environmental Quality Standards Directive (EC-EQSD, e.g. Art. 3), respectively.

2.) Protection of Groundwater Ecosystems against Pollution

Groundwater ecosystems are the largest and oldest freshwater habitats. Nonetheless, in European water legislation, groundwater is treated exclusively as a resource but not as an ecosystem. On the basis of scientific knowledge and even in the context of general water laws, this discrimination is not justified.

At the global scale, the perception that groundwater ecosystems deserve protection similar to surface aquatic and terrestrial ecosystems is supported by the United Nations – 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals. One target in Goal 6 (6.6) clearly asks to protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes by 2020 (Resolution of the UN general assembly from 25.09.2015). Referring to this target, aquifers do without doubt have the status of an 'ecosystem' and deserve protection. Furthermore, the

UN World Water Development Reports (e.g. 2016, 2017, 2018) strongly emphasize the inadequate recognition of ecosystems' roles in water managements, including groundwater.

Although groundwater is yet treated as a resource, the EC-GWD mentions in its introduction section that groundwater is an 'aquatic ecosystem'. Indeed, the EC-WFD and EC-GWD set the legal framework overruling national laws. Some of the defaults are:

- The requested 'improvement of the status of aquatic ecosystems' applies likewise to traditional inland waters (surface waters) and groundwater (Article 1a; EC-WFD).
- In Article 1 of the EC-WFD and EC-GWD the prevention and restriction of groundwater contamination and the need for assessment criteria are explicitly mentioned.
- 'Heat' (warming of waters) is clearly defined as a pollution (Art. 2, EC-WFD).
- EC-WFD, in its goals, envisages a stepwise reduction of groundwater contamination (improvement of groundwater quality) (Art. 4 (1) b iii). This does not only apply to contamination by chemicals, but includes heat as well as hygienic parameters. This particular goal is, together with others as mentioned in Article 4, the legal basis of the EU for detailed management and action plans ([Article 4, Paragraph 1](#)).
- Where an improvement is plausibly not possible, adverse effects must be kept at a minimum (EC WFD, Art. 4 (5) b).
- The EC-GWD from 2006 states explicitly in its recital (20) "Research should be conducted in order to provide better criteria for ensuring groundwater ecosystem quality and protection" and "Where necessary, the findings obtained should be taken into account when implementing and revising this directive. Such research and dissemination of knowledge, experience and research findings needs to be encouraged and funded." Ten years have passed since release of the EC-GWD. And although comparably little money was spent by the EU Commission dedicated to such research, a large amount of new and comprehensive knowledge is available that underlines the uniqueness and importance of groundwater ecosystems also in terms of ecosystem services. Moreover, a set of tools has been developed ready to be applied for groundwater ecosystem status assessment and ecologically sound monitoring.
- Art. 8 of the EC-GWD (= technical adaptation) serves, in our opinion, not only for the further development of Annex II but without doubt also for an improvement in the aforementioned context. In connection with the assessment of groundwater we further refer to Art. 4 (5) EC-GWD where aquatic ecosystems are particularly mentioned. Together with consideration no. 20 of the recital, Annex IIb should be revised.

Interestingly, in the meantime the European Medicines Agency developed a „Guideline on assessing the environmental and human health risks of veterinary medicinal products in groundwater“ (EMA/CVMP/ERA/103555/2015) which came into effect on 1 November 2018. Central to this guideline is the assessment of negative effects of veterinary pharmaceuticals on groundwater ecosystems. It gives the protection of groundwater ecosystems a legal ground.

On 15 November 2018, the European Medicines Agency released for consultation the draft of a further guidance entitled "Guideline on the environmental risk assessment of medicinal products for human use" (EMA/CHMP/SWP/4447/00 Rev. 1), aimed at "protecting aquatic and terrestrial ecosystems including surface water, groundwater, soil and secondary poisoning - and the microbial community in sewage treatment plants". In this guideline, groundwater is considered an ecosystem fundamentally different to surface water ecosystems, more vulnerable and with a lower ability to recover from perturbations (Par. 4.2.6. "Groundwater"). It's the first time that groundwater ecosystems are considered in Europe with an applied background. In conjunction with the Regulation 2019/6 on veterinary medicinal products (Annex II, part III Nr. 6) protection of groundwater ecosystem is mandatory.

The legal situation of groundwater ecosystems in Europe is compiled by Hahn et al. 2018.

Additional criteria and indicators are available

The use of additional, ecological criteria and indicators will help to earlier recognize negative and positive trends in groundwater quality and ecosystem status. We thus highly recommend its consideration.

- ‚Heat‘ (and the alteration of groundwater temperature) is a ‚pollution‘. Temperature data and the deviation from a local or regional reference gives indication for a thermal stress. Groundwater ecosystems and their communities are particularly sensitive to temperature changes, especially to warming (Issartel et al. 2005a,b; Avramov et al. 2013; Griebler et al. 2015; Di Lorenzo & Galassi 2017). By using groundwater fauna, temperature thresholds can be delineated (Briellmann et al. 2013; Spengler & Hahn 2018).

Since the release of the EC-GWD, new approaches for the assessment of groundwater ecosystem status have been developed.

- An easy use of groundwater fauna as bio-indicators – by calculation of an index based on the differentiation of higher taxonomic levels - is ready to be used by small private companies (Guderitz & Hahn 2012, Robertson et al. 2017.). The impact of land use (Stein et al. 2010, Korbel & Hose et al. 2011, Griebler et al. 2014; Meleg et al (2014), Di Lorenzo et al. 2015), the influence of surface waters (Hahn et al 2006), the degree of vulnerability, and the ecosystem stability and resilience (Gutjahr 2013; Galassi et al. 2014; Reiss et al. 2018) can all be determined. Proposals for regional references are also available (Stein et al. 2012, Gutjahr et al. 2014, Weitowitz et al. 2017).
- The easy to apply and comparatively cheap B-A-E concept allows a basic microbiological characterization of groundwater. Measurement of Biomass (B), Activity (A), and Energy (E) allows the determination of changes in groundwater quality that effect microbial processes or are a result of it (Griebler et al. 2018).
- Regarding ecotoxicology, it has been proposed to consider one order of magnitude lower thresholds for groundwater ecosystems than for surface waters (“Guideline on assessing the environmental and human health risks of veterinary medicinal products in groundwater“; EMA/CVMP/ERA/103555/2015; “Guideline on the environmental risk assessment of medicinal products for human use” “EMA/CHMP/SWP/4447/00 Rev. 1). According to this suggestion, one should evaluate and, where necessary, revise existing thresholds (e.g. EC-GWD, Annex II). Laboratory protocols and assessment schemes are in preparation (Di Lorenzo et al, in prep. a, b).

Recommended Actions

- The high standards of the EC-WFD have to be maintained. Their implementation has to be based on the consequent application of its requirements and of the recitals and requirements of the EC-GWD according to new scientific knowledge and data. For the protection of groundwater and groundwater ecosystems the new indicators mentioned above should be added to the minimum list of parameters to Annex IIb of EC-GWD as a technical adaptation.
- Heat as a pollution and monitoring parameter has to be added to Annex IIb of EC-GWD as a technical adaptation
- The European Commission explains how to monitor and improve groundwater ecosystems.

3.) Precautions against Riverbed Colmation

Colmation means the clogging of the riverbed interstices (Hyporheic Zone, HZ) by fine sediments. The EU Technical Report on Groundwater Associated Aquatic Ecosystems – GWAAE (Technical Report - 2015 – 093) defines the hyporheic zones as a GWAAE, i.e. small spaces in the sediment of rivers,

lakes and estuaries critically dependent on groundwater. Oxidic groundwater discharge through the river bed maintains the oxidic and temperature conditions that are critical for the surface water ecology. The presentation of GWAAE is a key objective of the EU Water Framework Directive. Anthropogenically increased fine sediment impact from the catchments (in particular grain sizes < 0,2 mm, like fine sand, silt, clay) often boost natural colmation processes. Although, the significance of colmation for the degradation of stream biocoenosis is increasingly recognized (Wharton et al. 2017), it's completely disregarded for the stream assessment according to EU Water Framework Directive (EC-WFD). EC-WFD expected the Good Ecological Status for all European surface waters which were not heavily modified by 2015 at the latest. Only in exceptional cases can this deadline be extended to 2027. However, recent studies indicate that these targets have not been achieved in most cases (e.g. Ölmann, Haase et al. 2015, DBU-Bericht) – probably also as a result of colmation (Stein et al. 2018a).

Additional criteria and indicators

It seems that there are direct correlations between EC-WFD assessment (macrozoobenthos), hyporheic fauna and colmation. Measurements of colmation as well as the recording of hyporheic fauna at higher taxonomic levels (e.g. orders) provide improved information on the cause of deviations from the quality standard. Thus, based on an adapted monitoring program, these indicators may be a starting point for target-oriented measures to reach the Good Ecological Stage.

Additionally, fine sediments are vectors for numerous contaminants. Thus, for many colmated streams a higher pollutant load is to be expected.

Concluding, it's urgently recommended to consider parameters relevant for colmation in the EC-WFD (Annex V, Art. 1.1 Quality Components) or in the Environmental Quality Standards Directive (EC-EQSD, Directive 2008/105/EC) (e.g. Art. 3). This means:

- Meanwhile, it's technically possible to measure quantitatively the permeability (in terms of colmation) of the Hyporheic Zone. Based on regional references (yet to be defined, s. EC-WFD Annex II, Art. 1.3 Establishment of type-specific reference conditions for surface water body types), the quantitative measurement of colmation will be an additional tool for the objective assessment of streams. (Stein et al. 2018b).
- Since the hyporheic fauna reflects, even on a higher taxonomic level, the degree of colmation, the definition of faunistically based assessment scheme for colmation is possible (Annex V, Art. 1.1 Quality Components). Efficient molecular tools are in place to assess streambed / hyporheic community composition in a standardised manner (Weigand & Macher 2018).
- Analysis of fine sediments according to EC-EQSD

Colmation-related parameters/indicators have to be considered and implemented by the Management Plans. This also includes modelling of erosion and flow paths of fine sediments, leading to a catchment-related adapted stream and sediment management.

Recommended Actions

- The high standards of the EC-WFD have to be maintained. Their implementation has to be improved and new scientific knowledge and data must be regarded.
- Colmation should be considered by the Environmental Quality Standards Directive (EC-EQSD, e.g. Art. 3), for example when deriving environmental demands for additional priority substances. This could be linked to pollutants in sediments.
- The European Commission explains how to monitor and prevent colmation.
- The topic colmation will be discussed by the responsible CIS-working group

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