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Briefing on the European Commission Proposal for a Directive on the protection of groundwater against pollution COM (2003) 550

Prepared for the European Parliament Committee on Environment, Public Health and Consumer Policy

INTRODUCTION

The Committee on Environment, Public Health and Consumer Policy of the European Parliament has made a contract with the European Academies' Science Advisory Council (EASAC) for the provision of technical-scientific advice in the area of Environment Public Health and Food Safety (project EP/IV/A/2003/09/02). As part of the contract, the Committee has commissioned a review of the European Commission's proposal for a Directive on the protection of groundwater against pollution, contained in the Commission document COM (2003) 550.

Ten independent experts have reviewed the scientific aspects of the draft Directive, and their comments are summarised in this paper. The experts came from Austria, France, Italy, Germany, the Netherlands and Slovenia. Their expertise covered the fields of hydrogeology, hydroecology, zoology, biology and speiliobiology, ecotoxicology and microbiology.

This review focuses on the scientific and technical merits of the proposal. As agreed, it does not address issues of cost, which are beyond the competence of the EASAC member Academies.

SUMMARY

This proposal is for a Daughter Directive to the Water Framework Directive to establish criteria for the assessment of good chemical status and for determining trends in groundwater throughout member states.

The proposal has been widely welcomed by our reviewers as a timely and necessary adjunct to the Water Framework Directive.

Our reviewers have, however, expressed severe reservations about the scope of the Directive and about specific elements that combine to reduce its effectiveness.

In particular, they have major concerns that the proposed Directive treats groundwater only in terms of its chemical quality and fails to recognise the importance of groundwater bodies as ecosystems. This matters as the ecological aspects of groundwater – for example, the activities of micro-organisms – are important both for the functioning of groundwater bodies and for monitoring.

Our reviewers consider the treatment of the European groundwater systems to be too generalised and over-simplified. They point out that the complexities in groundwater systems are crucial to an understanding of their quality and of the measures that will be needed to ensure that they continue to function effectively in future.

Reviewers are agreed that more consideration should to be given to the provisions for monitoring. In particular they have concerns about frequency and duration and about the indicators of quality that have been chosen.

In summary, our reviewers see this proposal as a good start on an important problem, but they consider that there is much to do if the measure is to deliver as legislators might expect.

GENERAL COMMENTS

(i) Groundwater systems as ecosystems

Groundwater is an important natural resource. It acts as a reservoir from which high quality water can be abstracted for drinking and for use in industry and agriculture. It is also used by a wide range of organisms, from the micro-organisms directly in the groundwater to the plants and animals at the surface of the earth. It is, therefore, a fully functioning ecosystem in its own right.

Groundwater provides energy for organisms including the rich spectrum of bacteria that work in the process of in situ water purification, and for subterranean animals ranging from worms and crustaceans to amphibians. Hence, groundwaters display a high degree of functionality. They act as a life support system and not simply as a resource to be used for human consumption as 'drinking water, and for industry and agriculture' (see section Groundwater: a resource at risk, proposed EC-Groundwater Directive p. 2, 3).

It follows that the Groundwater Directive should aim to protect aquifers as diverse groundwater ecosystems, and should not restrain the concept of

protection to an abiotic 'body of groundwater' (the proposed EC-GW Directive p. 6 & 8). Note that the Water Framework Directive 2000/60/EC (WFD) defines a body of groundwater as a distinct volume of groundwater within an aquifer (Art 2/12).

A selected bibliography on groundwater ecology is attached at the Annex. This is just a part of the wide-ranging and important literature that could usefully be taken into account by the Commission in revising this proposal.

Measures to protect groundwater against pollution should not be restricted to the good chemical status of the subterranean resource but should also aim to prevent the loss of its ecological function. This means preserving the diversity of ecosystems both within the subsurface aquifer and in the overlying layers of soils. There are published sources of information on how this can be done, for example reference c in the Annex, in a chapter on managing ecological risks of groundwater pollution.

The preservation of groundwater ecology is particularly important because of the role it plays in maintaining groundwater quality. Groundwater organisms are especially important for the self-purification processes of groundwater systems, so the maintenance of a high diversity of micro-organisms is extremely important.

Bacteria and invertebrate and vertebrate animals can also contribute to assessment of trends in groundwater quality. They can be selectively used as indicator organisms to give more complete information about the qualitative state of groundwater ecosystems. The diversity of these organisms should therefore be mapped better at an early stage and further used for environmental monitoring. A European project PASCALIS (EVK2-CT-2001-00121) deals with these aims and the expert commission of the proposed EC-GW Directive should consider this information for the final version of this document.

(ii) Geographic and geological differentiation

Our reviewers all expressed concerns that there was so little differentiation between the different hydrological regimes within Europe and between different geological conditions. There are, for example, very different problems associated with karstic systems (in limestone with many fissures and pot holes) and groundwaters in more homogenous but porous materials. In the former systems, water from the surface can enter rapidly into the groundwater system whereas in the latter case there may be significant filtering.

Geographically, special attention should be given to the northern, central and southern European regions when discussing the monitoring programmes for groundwater protection. For example, there are differences in the origin of the salinisation of groundwater in various European areas. There is saline

water intrusion in the peri-Mediterranean areas, eg southern Italy, Greece, Spain and Portugal, due to over-pumping while in other European regions the salinisation is mainly the result of intensive agriculture procedures.

Further issues arise with complex systems of multiple groundwater bodies in the same location, for example in river deltas where there may be shallow groundwater bodies above deeper groundwater bodies. In these regions there is a strong interaction between groundwater and surface water. As a consequence flow paths and residence-times are short (typically up to 25 years). These shallow, almost ‘local’ systems, the top-systems, are often polluted. The deeper regional groundwater bodies have small interactions with these shallow systems, the water is mainly transported laterally and originates from areas far away, and consequently the residence times are large (typically hundreds or thousands of years). Pollution in these deeper systems is very rare. Considering the top system and the groundwater system as one groundwater system will make pollution invisible, as will be confirmed by monitoring mean values. There are therefore two options: to distinguish shallow groundwater systems from those that are deeper or to consider the top-system as part of the surface water bodies. But the proposal does not mention this problem and gives no criteria to distinguish between these very different kinds of groundwater body.

(iii) Groundwater pollutants coming within the proposal

Our reviewers comment that the distinction between those pollutants that may either be of natural origin or due to human activity and those that are man-made substances is helpful. They felt, though, that a further distinction between old and new pollution from human activity should be made. This would help to focus preventative action on current causes of groundwater pollution. The measures necessary to clean up after legacy pollution could then be assessed separately.

A number of substances should be added to the list in Annex III of the Commission’s proposal, including, in Part A.1, chromium and nickel, and, in Part A.2, other halogenated solvents, polyaromatic hydrocarbons (PAH) and ozygnenates such as MTBE.

(iv) Assessing groundwater resources

As an important resource, Europe’s groundwaters certainly need action to prevent further deterioration in their quality. However, there is an important link missing in the Commission’s current proposal. That is the importance of the quantity of groundwater within aquifers in Europe. One of our reviewers points out that the volumes of groundwater have come under threat from increased extraction and from changes in regional rainfall patterns. Changes in rainfall predicted as a result of climate change would

affect the recharge of groundwater bodies and place volumes under further strain.

There is, of course, a link between quality and quantity. If volumes of groundwater decrease there will be an increase in the concentrations of pollutants.

It is therefore suggested that the Commission should consider ways within the proposed Directive of ensuring that member states carry out the necessary assessment of groundwater reserves. It is accepted that this is not a simple task, but there is a strong feeling that it must be started at some stage. A Directive that contains provisions for monitoring groundwater quality seems to be a good place to start.

SPECIFIC COMMENTS ON THE COMMISSION'S PROPOSAL

(Numbers refer to the pages and sections in the Commission Document COM(2003) 550 final.)

Page 2 and 3, Groundwater: a resource at risk

2.1 Should include reference to ecological importance of groundwater bodies.

2.2 Consequences of water pollution are very exceptionally of the order of a month. The more normal scale is a decade. The mean speed of flow in an alluvial reservoir is of the order of a meter a day.

Our reviewers consider that the treatment of polluted groundwater after extraction is not feasible and would be economically unacceptable. Only preventative action is really viable for managing groundwater quality.

Page 7 Links to sustainable development

7.1 This should stress the necessity for better protection of relevant groundwater ecosystems. This section should also include:

a statement on the need to identify the hydrological situation with reference to sustainable yield of aquifers (ie the hydrological status of groundwater systems). This should be decided according to the hydrological, ecohydrological and economical aspects of the aquifer in question;

a paragraph on the assessment of the ecological status of an aquifer system (not only the chemical status). Here emphasis should also be given to groundwater/surface water ecological parameters, including the biological ones that pertain to groundwater organisms;

a paragraph on the importance of the horizontal links between the present proposed EC-GW Directive and other EC environmental strategic

frameworks and/or directives, including the EC-Biodiversity Strategy, the Natura 2000 Strategy, the Thematic Soil Strategy and CD 92/43/EEC - Conservation of natural habitats and of wild fauna and flora.

Groundwater is not mentioned as a priority habitat in the Habitat Directive, and the Juberthie Report (1995, Council of Europe ISBN 92-871-2672-0) on the underground habitats and their protection deals exclusively with caves and terrestrial fauna. It is important therefore to include this aspect in the proposed EC-GW Directives.

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It would be good to include a provision for protecting groundwater against over-exploitation. Although this may be beyond the scope of this Directive, it is an important matter and it should be flagged up for the future, if not in Article 1 then at least in the preamble.

Articles 1 and 3 of the proposed EC-GW Directive (p.10 and 11 resp.) could usefully be reformulated to embrace the ecological aspects of groundwater quality, for example as following: 'criteria for the assessment of good groundwater chemical status and good groundwater ecological status'.

Note that the reference to the ecological status of surface water bodies or aquatic systems exists in the Water Framework Directive. In does not, by contrast, appear in the Commission’s draft for the proposed EU Groundwater Directive.

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On limits and threshold values, the proposed Directive suggests limit values for two major pollutants, nitrates (inorganic) and pesticides and their metabolites (organic). Our reviewers believe that the limit value for the pesticide is acceptable (limitation can be only at the detection limit) but for nitrates they have expressed doubts. For example, in karstic areas, due to lack of green plants, self-purification may not function well and may lead to higher nitrate values in groundwaters. In these cases, the nitrate pollution could be prevented only through the effective control of large catchments. Therefore limits have to be fixed according to geographical as well as well as hydrogeological characteristics of the region.

Article 3 of the proposed Directive will need amendment in the near future to include biological and ecotoxicological criteria for assessing the quality status of groundwater systems and/or habitats. Suitable parameters have to be defined either now or in the near future, as it was done in the past for other aquatic environments and/or terrestrial ecosystems. Examples may be found in the Water Framework Directive 2000/60 EC.

It will be important to review periodically the different sources of pollution, including new sources such as MTBE or xenobiotic pollutants as well as the diverse human activities that produce stress or impair the quality of the groundwater or the functionality of ecological systems.

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Article 6 should be revised to include the point that besides river basin districts one should protect also groundwater basins against indirect (diffuse) penetration of pollutants into groundwater. This amendment would apply especially to aquifers where water does not necessarily infiltrate along the river banks (bank infiltration areas).

Page 16 Annex IIIa

Section A.2 could be split into legacy and new pollutants. Further elements and compounds as above, and representative agrochemical products, fertilisers and pesticides, should be included.

Page 17 Annex IIIb

This could usefully include information on the monitoring networks established by member states, number of sampling points, type of sample extraction and measurands, for example.

Page 18 Annex IV, 1.2

It is essential at the outset to distinguish between different methods of sampling at the individual monitoring points. If the samples are taken from a well, for example, then it is possible to have a representative mean value of water quality over some millions of cubic meters, whereas a sample taken from a piezometer would represent a far smaller volume, of the order of dozens of cubic meters.

The questions of duration of measurements and their frequency are complicated by the variability in time and space of the dynamics of groundwater systems. Account has to be taken not simply of the speed of movement of water within the reservoir but also the speed in the surrounding soils and rocks that can form areas of storage for pollutants. To take account of these dynamic effects, the minimum duration of sampling should be ten years.

The dynamics vary considerably during the year. Measurements should therefore be made quarterly during the first five years to explore the changes between seasons, and then to move to bi-annual sampling.

For 1.2 (b) one of our reviewers points out that the elimination of measurements below the level of detection would distort the results and suggests that a number equivalent to half the detection limit is inserted (as the mean value of a measurement just below the detection limit and zero).

Similarly, there are difficulties in interpreting the statistics if the measurement frequency changes. The Commission may wish to take this to their expert statisticians for an opinion.

On a highly specific note, one of our French reviewers was of the opinion that the French version of the text needed further work. He points to the phrase in the introduction 'difficile a nettoyer' as an example, better rendered as 'difficile a depolluer'.

CONCLUSIONS

This proposal is important and timely. Our reviewers are unanimously of the view, however, that as it stands it is too blunt to be effective. In their view, there should be a far more sophisticated approach to this problem, taking account of geographical and hydro-geological differences and of the need to consider groundwater bodies as ecological systems.

ANNEX SELECTED BIBLIOGRAPHY ON GROUNDWATER ECOLOGY

(a) Danielopol, D.L., Griebler, C., Gunatilaka, A. & Notenboom, J. 2003. Present state and prospects for groundwater ecosystems. *Environmental Conservation* **30**: 104-130.

(b) Griebler, C. & Mösslacher, F. (Eds.) 2003. *Grundwasser-Ökologie*, Facultas, Vienna.

(c) Griebler, C., Danielopol, D.L., Gibert, J., Nachtnebel, H.P. & Notenboom, J. (Eds.) 2001. *Groundwater Ecology, a tool for management of water resources*. Office for publications of the EC, Luxembourg. (Note that this book presents the proceedings of a Groundwater Ecology Course organised by the EC through its Department for Science, Research and development -DG 12, Brussels).

(d) Culver, D.C., Deharveng, L., Gibert, J. & Sasowsky, D. (Eds.) 2001. Mapping subterranean biodiversity. Proceeding of an international workshop, 18-20 March 2001 at Moulis (France). Special Publication 6, Karst Water Institute, Charles Town, West Virginia.

(e) Wilkens, H., Culver, D.C. & Humphreys, W.F. (Eds.) 2000. *Subterranean ecosystems*, Ecosystems of the world, 30, Elsevier, Amsterdam.

(f) Gibert, J., Danielopol, D.L. & Stanford, J.A. (Eds.), 1994. *Groundwater Ecology*, Academic Press, San Diego.

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