



MARSOL

Demonstrating Managed Aquifer Recharge as a Solution to Water Scarcity and Drought

Policy document for decision makers

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1 Introduction

The main objective of the MARSOL Project is to demonstrate that Managed Aquifer Recharge (MAR) is a sound, safe and sustainable strategy that can be applied with great confidence. With this, MARSOL aims to stimulate new and innovative technologies to support the use of conventional and alternative water resources in MAR in order to optimize Water Resource Management. Widespread application of MAR can help address water security problems in water scarce regions to stimulate economic development, improve public health and well-being, and maintain ecological functions and biodiversity. MAR is also being increasingly considered as an effective tool to address the adverse impacts on water security arising due to climate change. The use of MAR technologies can substitute the need for other, more energy-intensive water management and supply options such as seawater desalination and thus promote cost effective local solutions to address water scarcity by enhancing adaptability and resilience at the local level.

Furthermore, the integration of MAR in water management planning has the potential of opening up new market opportunities which can lead to the development of innovative MAR technologies and solutions, thus supporting the development of the EU's green economy. Furthermore, the application of MAR technologies will open up job creation opportunities in the development and management of the MAR schemes and through the expansion of economic activities as a result of the increased availability of water (increased ecosystem services) which can have an important economic impact at the local level.

MAR is a widely adopted water management technique in countries like Australia and the United States, where policy and regulatory frameworks manage the potential risks associated with MAR but encourage it as an important component of their approach to integrated water resource management.

2 Regulatory Perspective

The Water Framework Directive (WFD, 2000/60/EC) considers artificial recharge of groundwater as one of the management tools that can be used by EU Member States for the achievement of good groundwater status. In fact, whilst listing artificial recharge as one of the basic measures to be considered by Member States in their River Basin Management Plans, Article 11(3)(f) of the Directive requires the establishment of “controls, including a requirement for prior authorization of artificial recharge or augmentation of groundwater bodies”. This is to ensure that the necessary regulatory controls are in place to ensure that such practice is undertaken in a safe way which does not “compromise the achievement of the environmental objectives established for the source or the recharged or augmented body of groundwater”. The provisions of the WFD in this regard, are directed to ensure that the necessary controls are in place to eliminate the possibility of the incorrect application of managed aquifer recharge scheme leading to any degradation in the qualitative status of the receiving body of groundwater. The scope of the MARSOL project is that of demonstrating that managed aquifer recharge is an effective tool to address water management issues which can be undertaken in full respect of the regulatory requirements of the WFD and thus in a safe way which leads to benefits to the water environment.

In this regard, Article 4(1)(b)(i) of the Water Framework Directive requires Member States to implement the measures necessary to prevent or limit the input of pollutants and to prevent the deterioration of the status of all bodies of groundwater. The Groundwater Directive then introduces the necessary provisions for making the WFD’s ‘prevent or limit’ objectives operational. According to CIS Guidance Document No 17¹, under the Groundwater Directive, substances to be PREVENTED from entering groundwater are those substances which have been identified by Member States as being hazardous. In as much, one may consider that the substances which need to be LIMITED in groundwater such that pollution does not occur are all other pollutants.

In this respect it is noted that the Groundwater Directive (2006/118/EC) recognizes that it is not technically feasible to stop all inputs of hazardous substances, in particular the input of some small inputs of hazardous substances which are environmentally insignificant and thus do not present a risk to groundwater. For such cases the Groundwater Directive, under Article 6(3)(d) introduces a series of exemptions Artificial recharge is considered under these exemptions. CIS Guidance Document 17 provides an interpretation of this prevent and limit concept. According to this EU Guidance Document, to PREVENT an input into groundwater therefore means: Taking all measures deemed necessary and reasonable to avoid the entry of hazardous substances into groundwater and to avoid any significant increase in concentration in the groundwater, even at a local scale. It is understood that these measures can include source water quality and flow control mechanisms and upstream treatment of the recharge source water.

¹ CIS Guidance Document 17 on preventing or limiting direct and indirect inputs in the context of the Groundwater Directive published by the European Commission under the Common Implementation Strategy of the Water Framework Directive.

In this regard it is however noted that the prevent and limit conditions are also a requirement of the Water Framework Directive under Article 4(1)(b)(i). Therefore, although the Groundwater Directive under Article 6(3)(d) introduces an exemption for Artificial Recharge² schemes permitted under Article 11 of the WFD from the prevent and limit requirements introduced under the Directive's Article 6(1); the fact that Article 6(3)(d) of the GWD required a permit that was issued under the WFD implies that the permit should in itself already give due consideration to the WFD's prevent and limit objectives. It is felt that this is a grey area between the two Directives, which can potentially give rise to interpretation conflicts.

In fact, the CIS Guidance Document 17 provides an excellent example of the situation which may arise when the Groundwater Directive in the context of the regulation of MAR schemes is considered in isolation. The Guidance Document proposes a scheme for assessing whether new activities may result in inputs that are acceptable, i.e. whether they meet the requirements of the Water Framework Directive. This scheme is based on the following decision points:

- Does this activity fall under an existing exemption of GWD Article 6 or is an exemption planned, e.g. is the input so small as to obviate any present or future danger of deterioration in the quality of the receiving groundwater?
- Is the input direct or indirect?
- Is the substance hazardous or non-hazardous?
- Can sufficient controls be put in place to prevent or limit the substance from entering groundwater?

On the basis of this analysis, the Guidance Document proposes a decision support system to assess the eligibility of new activities with the requirements of the Water Framework Directive. Since Article 6 of the Groundwater Directive considers artificial recharge under its exemptions, the scheme developed under the WFD CIS Guidance Document can effectively be reduced to a single decision point for artificial recharge schemes permitted under Article 11(3)(f) of the WFD. It is felt, that this interpretation can lead to situations which do not lead towards the establishment of the necessary level of protection to ensure that MAR schemes do not negatively impinge on the qualitative status of the receiving body of groundwater.

² The Water Framework Directive and the Groundwater Directive use the broad term of Artificial Recharge which refers to both planned (managed) and unplanned artificial groundwater recharge.

3 Project Results

Given the significant potential for MAR to help communities adapt to the challenges of drought and water security, the MARSOL project is therefore proposing a regulatory framework (Fig. 1) which can be commonly used in EU Member States to ensure that MAR schemes are implemented in line with the requirements of EU Environmental Legislation. The proposed framework interprets the 'prevent or limit' requirements introduced under the Water Framework Directive in the light of the interpretation developed under the Groundwater Directive.

This proposed regulatory structure, which is schematically illustrated below, is based on the following principles:

- (i) The undertaking of a risk assessment to determine the potential impacts which could arise as a result of the MAR scheme on the status of the body of groundwater;
- (ii) The establishment of control mechanisms to ensure the reliable performance of the MAR scheme; and
- (iii) Monitoring of the performance of the MAR scheme and its impact on the augmented body of groundwater.

This three-tiered assessment structure has also been developed with the aim of harmonising and integrating the regulatory requirements of the Water Framework and the Groundwater Directive with the vision of the Environmental Impact Assessment Directive. This since the proposed regulatory assessment can effectively be considered as an Environmental Impact Assessment for MAR schemes in its own right. It is felt that this approach further supports the achievement of the Water Framework Directive's environmental objectives for groundwater bodies.

Each assessment level under this scheme includes a number of decision levels which must be addressed in the MAR scheme evaluation process. The technical protocols to enable the compliance assessments at each decision level have been developed based on the results of the Project's horizontal work-packages which focused on the following issues:

- (i) Investigation and monitoring
- (ii) Numerical Groundwater Modelling
- (iii) Water Quality
- (iv) Economic Feasibility and Benefits, and
- (v) Technology Assessment and Risk.

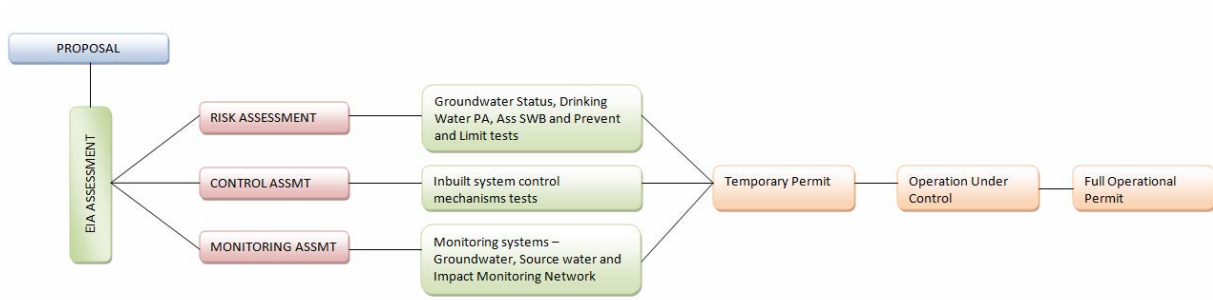


Fig. 1: Proposed MAR Regulatory Scheme under the MARSOL Project.

4 Project Recommendations

The conclusions of the MARSOL Project thus confirm that Managed Aquifer Recharge can be considered as an effective tool to address the achievement of good groundwater quantitative status especially in water scarce regions and, in particular in view of emerging challenges due to climate change impacts. The project also highlights that the technical tools are available to support the development of the necessary controls to ensure that MAR is undertaken in a way which is safe to human health and the environment. This is of particular importance due to the inherent link between groundwater's quantitative and qualitative status, where water of poor qualitative status in reality is unavailable for use, thereby exacerbating the quantitative issue.

The project recommends the development of common regulatory controls, necessary to ensure the application of good MAR practice in all EU Member States where the application of MAR schemes is required. This will however require the establishment of a common definition of the 'prevent and limit' requirements under the Water Framework Directive, ideally reflecting those achieved under the Groundwater Directive. This also addresses the potential direct application of exemptions arising from the interpretation of the Groundwater Directive's Article 6 exemptions in isolation.

MARSOL puts forward the technical results achieved from its horizontal work-packages, which can effectively contribute to the better development and regulation of MAR techniques. In particular, it highlights the needs for controls over the quality and the reliability of the source water quality and the application of effective monitoring technology as key aspects in ensuring the safe application of MAR schemes. Furthermore from a socio-economic perspective, it outlines the need for the adoption of a wide economic framework under Article 9 of the WFD, which takes due consideration of the environmental, resource and economic benefits generated by the MAR activity in the river basin context when undertaking project feasibility assessments.

The project highlights the Regulatory Framework based on risk assessment, control mechanisms and monitoring as a tool which can facilitate the interpretation of the requirements of the Water Framework and Groundwater Directives in relation to MAR, and calls for the development of a specific action on MAR to be established under the WFD CIS to provide clear guidelines to Member States on the application of MAR techniques in their 3rd River Basin Management Plans in line with the requirements of the Water Framework and Groundwater Directives.

The partners of the MARSOL Project therefore:

1. Outline that Managed Aquifer Recharge is an effective and safe tool to address the achievement of good groundwater status, in particular in view of the emerging challenges due to Climate Change;
2. Highlight the importance of Managed Aquifer Recharge being undertaken in a way which is safe to human health and the environment;

3. Note the important links between water quantity and water quality, and that water of poor quality is unavailable for use;
4. Highlight the need for the necessary regulatory controls to be established to ensure the application of good Managed Aquifer Recharge practice;
5. Note that the Article 6 exemptions under the Groundwater Directive, can potentially give rise to conflicts with the Water Framework Directive leading to the application of exemptions which do not safeguard the safe application of Managed Aquifer Recharge techniques;
6. Recommend the establishment of common definition of the 'prevent and limit' requirements under the Water Framework and Groundwater Directives;
7. Highlight the main technical results of the MARSOL project and outline how these can contribute to the better development and regulation of Managed Aquifer Recharge techniques;
8. Outline that a wide economic framework is required for the application of the Cost Recovery Principle to Managed Aquifer Recharge schemes, which takes in to consideration of environmental and resource benefits generated by the Managed Aquifer Recharge activity;
9. Highlight the regulatory structure proposed under MARSOL based on risk assessment, control mechanism and monitoring as a tool which can facilitate the interpretation of the Water Framework Directive and the Groundwater Directive and thus ensure that managed aquifer recharge schemes are developed in a way which ensure their application in a way which is safe to human health and the environment; and
10. Call for a specific action on Managed Aquifer Recharge to be established under the WFD Common Implementation Strategy to provide clear guidelines to Member States on the application of MAR techniques in their third River Basin Management Plans (RBMPs).