Thematic Assessment of Groundwater Quantitative Status

Deliverable 4

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1. Abstract and Key Messages

(Chapter to be drafted for final draft 15 June 2012)

2. Introduction

2.1. Main objectives of the assessment of groundwater quantitative status

The current report focuses on presenting and analyzing information around the quantitative status of the European Groundwater Bodies (Groundwater body). The background information has been collected from the WFD RBMPs. Based on the available data, a series of graphs has been produced, with the purpose of classifying the Groundwater bodies according to their quantitative status and identifying the main drivers and pressures. Furthermore, the report touches on the criteria used by the different Member States to classify the groundwater bodies, identifies and groups the response measures (basic and supplementary) adopted by the MS in view of improving the quantitative status by 2015 and beyond, and attempts an assessment of their effectives by linking pressures-state-impacts. A selection of case studies reflecting different management issues is also presented and key messages on actions needed in relation to securing good groundwater quantitative status are reflected.

2.2. Definition of good groundwater quantitative status

The definition of good groundwater quantitative status requires that the level of groundwater in the groundwater body is such that the available groundwater resource is not exceeded by the long-term annual average rate of abstraction.

Accordingly, the level of groundwater is not subject to anthropogenic alterations such as would result in:

1. failure to achieve the environmental objectives specified under Article 4 for associated surface waters,
2. any significant diminution in the status of such waters,
3. any significant damage to terrestrial ecosystems which depend directly on the groundwater body,

and alterations to flow direction resulting from level changes may occur temporarily, or continuously in a spatially limited area, but such reversals do not cause saltwater or other intrusion, and do not indicate a sustained and clearly identified anthropogenically induced trend in flow direction likely to result in such intrusions.

To determine the overall quantitative status for a Groundwater body, a series of tests should be applied that consider the impacts of anthropogenically induced long-term alterations in groundwater level and/or flow. Each test will assess whether the Groundwater body is

meeting the relevant environmental objectives. Not all environmental objectives will apply to every Groundwater body. Therefore only the relevant tests will need to be applied as necessary. There is an overlap with chemical status assessment for some elements of quantitative status assessment, in particular the assessment relating to saline intrusion. In this case the assessment for chemical and quantitative status for this element can be combined and a single test carried out. For others there will be a need to share information between the chemical and quantitative assessments.

2.3. European legislative setting in relation to groundwater

European water policy addresses issues regarding groundwater since the late 1970s. The first legislative instrument (Groundwater Directive 80/68/EC) was adopted in 1980 for the protection of groundwater against pollution caused by certain dangerous substances. The purpose of the Groundwater Directive was to prevent the pollution of groundwater by high priority substances, to subject the discharge of other substances to an authorization procedure, and to address the impacts of existing pollution. This Groundwater Directive (80/68/EC) remains effective until 2013 when it will be replaced by the new Groundwater Directive (2006/118/EC).

In 2000, the Water Framework Directive (2000/60/EC) came into force, establishing the basic principles of sustainable water policy in the European Union. The WFD provides a general framework for groundwater protection with the aim to establish good groundwater status by 2015.

Good groundwater status comprises of both quantitative and chemical criteria. In order to achieve good quantitative groundwater status, it is required that the long-term available groundwater resource is not exceeded by the long-term annual average rate of abstraction and that groundwater abstraction does not cause failure of good ecological status in dependent surface water bodies (incl. wetlands) and saline or other intrusions. In addition, in order to achieve good groundwater chemical status, groundwater bodies need to have such concentrations of pollutants and electrical conductivity so as not to exhibit effects of saline or other intrusions and cause failure of good ecological status in dependent surface water bodies (incl. wetlands).

Based on the WFD, member states are required to protect groundwater bodies by taking the following steps:

1. define groundwater bodies and classify the pressures and impacts of human activity on both chemical and quantitative quality
2. establish registers of protected areas within each river basin district, that include groundwater bodies that are used for the extraction of drinking water and are identified as

vulnerable under the Nitrates Directive 91/676/EEC, or affect protected areas defined by the Habitats Directive (92/43/EC) and the Birds Directive (2009/147/EC)

3. establish groundwater monitoring networks based on the results of the classification analysis so as to provide a comprehensive overview of groundwater chemical and quantitative status
4. include information regarding groundwater status within the river basin management plan (RBMP)
5. include the principle of recovery of costs for water services, including environmental and resource costs in accordance with the polluter pays principle
6. establish a programme of measures for achieving good groundwater status

The WFD (Article 17) required the proposal of specific measures to prevent and control groundwater pollution and achieve good groundwater status. Consequently, in 2006, the Commission adopted the new Groundwater Directive (2006/118/EC) on the protection of groundwater against pollution and deterioration. This new Groundwater Directive complements the WFD by requesting the establishment of groundwater quality standards and pollution trend studies, in order to reverse and prevent pollution and to comply with good chemical status criteria.

The above review of European Union's legislative setting, regarding groundwater, identified that the only legislation addressing the quantitative status of groundwater bodies is the Water Framework Directive.

3. Methodological approach and data sources

The background information has been extracted from the WFD RBMPs. Based on the available data, a series of graphs has been produced in order to cross-compare and assess the prevailing issues in relation to the quantitative status. The following data have been collected and analyzed:

- Groundwater bodies in good, poor and unknown quantitative status per country (2009)
- Groundwater bodies in good, poor and unknown quantitative status per country (2015)
- Pressures per Groundwater body: abstractions, artificial recharge, saltwater intrusions, other pressures and without these pressures per country
- Criteria use for the status assessment per Groundwater body
- Application of the definition of 'available groundwater resource' per Groundwater body and RBD
- Consideration of the balance between recharge and abstraction in the assessment, per Groundwater body and RBD
- Reasons for failure good quantitative status per Groundwater body
- Exemptions applied for reaching good quantitative status per RBD
- Information on Groundwater dependent terrestrial ecosystems (Groundwater Terrestrial Ecosystems)
- Basic measures for achieving good quantitative status in 2015 per RBD
- Supplementary measures for achieving good quantitative status in 2015 per RBD

For the analysis of status and pressures 135 RBDs (the total number uploaded in WISE) have been reviewed, while for the analysis of measures the report focused on the 15 RBDs, namely the ones where significant improvement is expected by 2015.

To complement the report case studies have been selected from the existing literature, while for a European overview of the aquifer types and groundwater resources available EU-wide maps have been retrieved from credible sources.

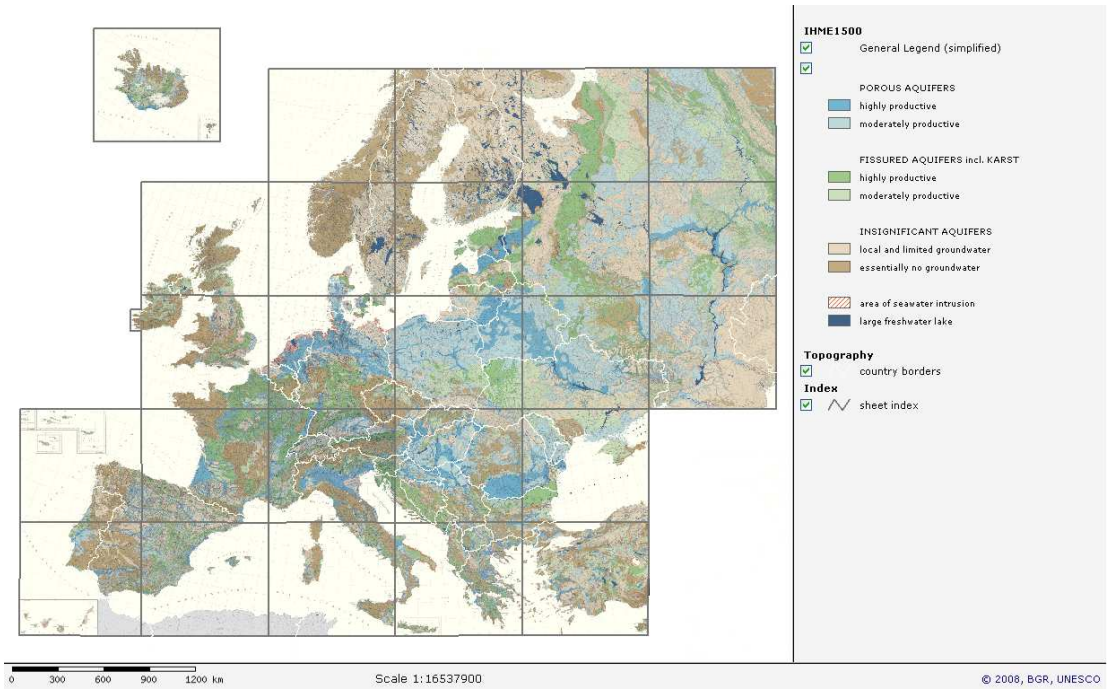
4. European Groundwater bodies

Groundwater bodies have been reported by 24 Members States. The total number of groundwater bodies reported is 12,635 and is derived from 135 RBDs. More than half of these groundwater bodies have been reported by Sweden and Finland (3,021 and 3,804 respectively) and are very small in size (on average 7 km2) when compared to the groundwater bodies of the remaining Member States (average size 600 km2). The total area of reported groundwater bodies is about 3.5 million km^2.

Existing EU-wide products are limited to the representation of main aquifers (Map 4.1). Regarding the quantitative state of European groundwater, data on recharge, groundwater available for annual abstraction and groundwater abstractions are collected by Eurostat on a country and annual basis, while European Environment Agency recently started the collection of groundwater level data (point data in selected wells), aquifer recharge and groundwater abstraction at RBD and SU level on a monthly scale. A representation of groundwater resources of Europe has been produced by BGR (Federal Institute for Geosciences and Natural Resources, Map 4.2) identifying areas of low to high recharge, areas of heavy water abstraction and over-exploitation, as well as areas of seawater intrusion.

Map 4.1 - International Hydrogeological Map of Europe 1 : 1 500 000 (IHME 1500)

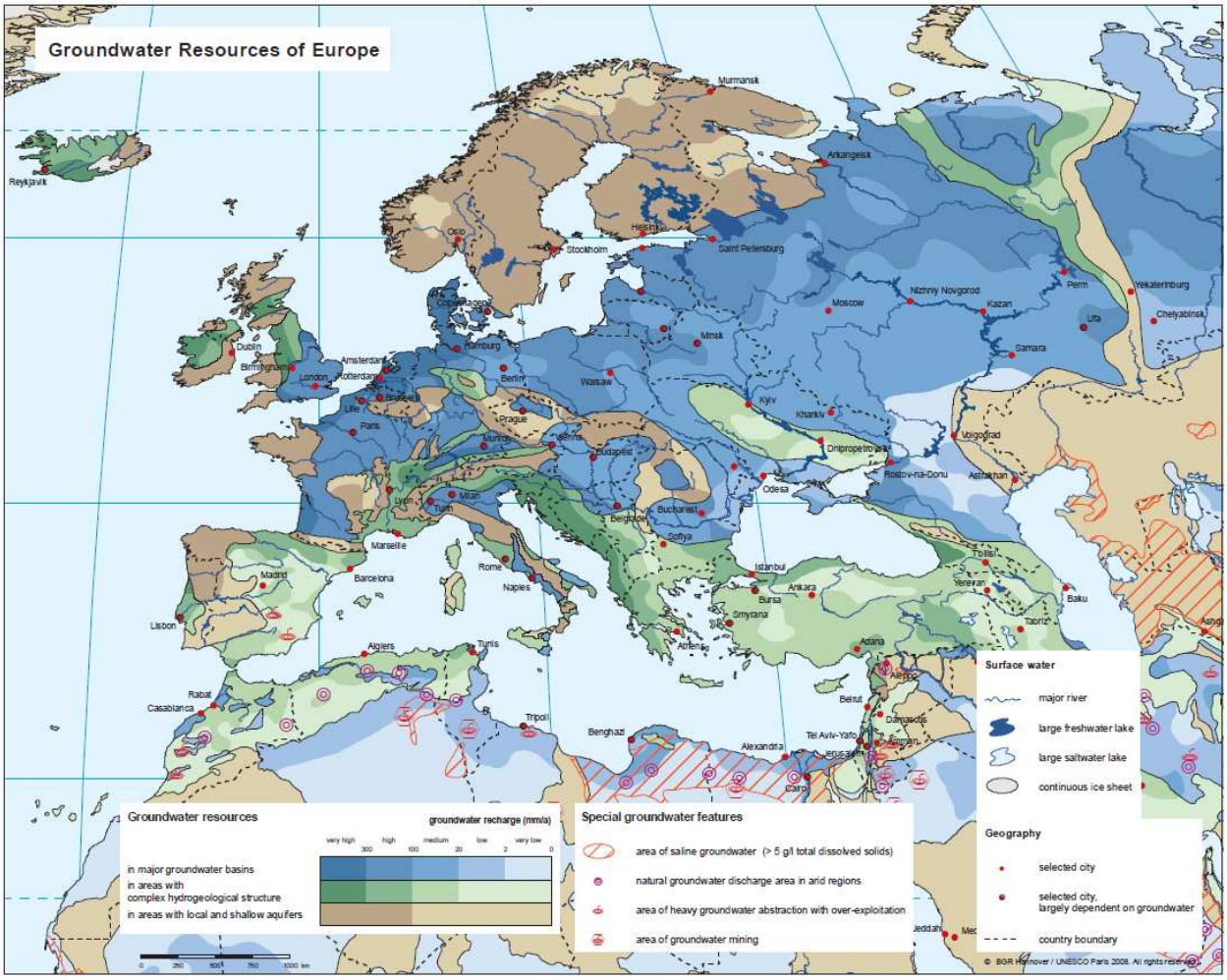
Source: Federal Institute for Geosciences and Natural Resources – BGR (Bundesanstalt für Geowissenschaften und Rohstoffe). http://www.bgr.de/app/fishy/ihme1500/



Note: The map contains classifications between porous and fissured aquifers (including karst) and indicates insignificant aquifers. Sub-classifications are shown in terms of productivity (i.e. highly productive, moderately productive, local and limited, insignificant aquifers)

Map 4.2 - International Hydrogeological Map of Europe 1 : 1 500 000 (IHME 1500)

Source: Federal Institute for Geosciences and Natural Resources – BGR (Bundesanstalt für Geowissenschaften und Rohstoffe).
http://www.whymap.org/whymap/EN/Downloads/Continental_maps/gwrm_europe_pdf.pdf?__blob=publicationFile&v=2



Note: The map identifies possible recharge to groundwater in Europe. The three main categories include (a) major groundwater basins (i.e., central and north Europe), (b) areas with complex hydrogeological structure (south and southeast Europe), and (c) areas with local and shallow aquifers (e.g., Scandinavian countries). Recharge in these areas is classified in five categories (i.e. very high, high, medium, low and very low)

5. Groundwater quantitative status

5.1. Overview of the groundwater quantitative status

According to the WFD (Annex V), for a Groundwater body to be of good quantitative status the following criteria (objectives) must be met:

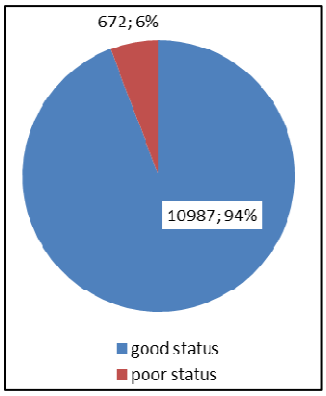
1. available groundwater resource is not exceeded by the long term annual average rate of abstraction;
2. no significant diminution of surface water chemistry and/or ecology resulting from anthropogenic water level alteration or change in flow conditions that would lead to failure of relevant Article 4 objectives for any associated surface water bodies;
3. no significant damage to groundwater dependent terrestrial ecosystems resulting from an anthropogenic water level alteration;
4. no saline or other intrusions resulting from anthropogenically induced sustained changes in flow direction

From the total number of Groundwater bodies assessed only 6% (672 Groundwater bodies) are classified as being in poor quantitative status in 2009, as depicted in

Figure 5.1. Only a few countries, namely Spain, United Kingdom, Belgium, Czech Republic, Germany, Italy, Malta, have groundwater quantitative problems which are though mainly found in specific RBDs and not in the whole country, with the exception of Cyprus where approximately 70% of its Groundwater bodies are in poor status (Figure 5.2). More specifically, the RBDs of Thames and South East in United Kingdom and Segura in Spain have more than 50% of their Groundwater bodies in poor status. The RBDs of Humber, North West and Anglian in United Kingdom, Quadalquivir, Jucar, and Andalusia Mediterranean Basins in Spain, Scheldt in Belgium, Elbe in Czech Republic and finally Maas in Germany have 30-50% of their Groundwater bodies in poor status. The RBDs of Severn in United Kingdom, Balearic Islands, Guadalete and Barbate in Spain, Danube and Oder in Czech Republic, Oder in Germany, Serchio, and North Appennines in Italy, and Malta have 20-30% of their Groundwater bodies in poor status. Finally, the RBDs of Dee, South West, North Eastern, Scotland and Northumbria in United Kingdom, Catalan in Spain, Central Appennines in Italy, national part of Danube in Hungary, national part of Danube in Bulgaria, and Meuse in Belgium have 10-20% of their Groundwater bodies in poor status (Map 5.1).

Figure 5.1 – Percent of Groundwater bodies in poor quantitative status in 2009

Data source:WISE-WFD database February 2012



Map 5.1 – Percent of Groundwater bodies in poor quantitative status in 2009 per RBD

Data source:WISE-WFD database February 2012

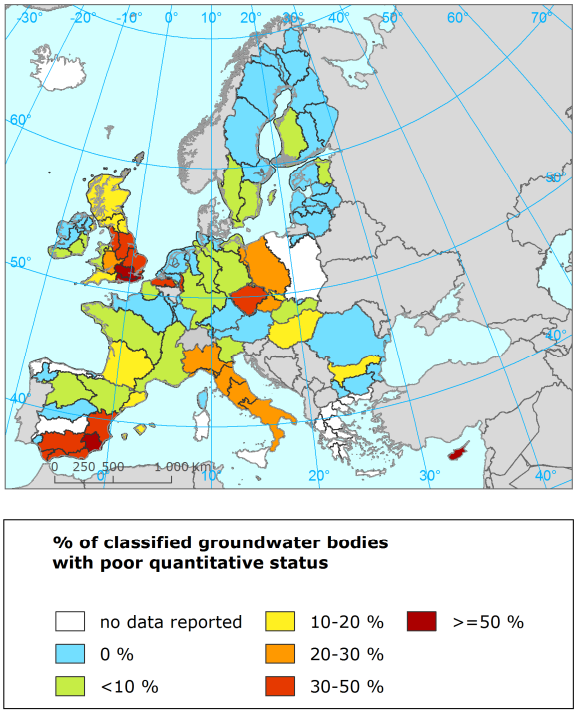
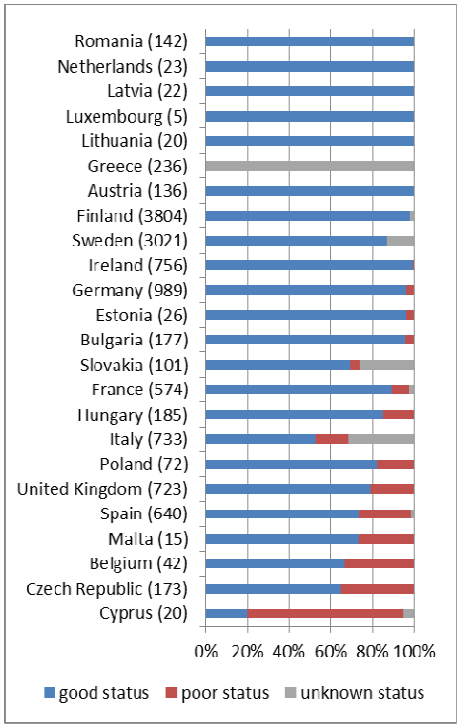


Figure 5.2 – Percent of Groundwater bodies in poor quantitative status in 2009 per Member State

* Number in brackets indicate the number of Groundwater bodies

Data source:WISE-WFD database February 2012



Complementarily to the classification of the status, an analysis of how the groundwater quantitative status assessment was performed by the Member States has been undertaken by comparing the criteria which were reported to be considered in the status assessment. It is noteworthy how key elements like 'available groundwater resource' or the assessment of the

balance between recharge and abstraction' have been considered in the Member states assessments.

Regarding the considered criteria (for status assessment), most commonly the balance between recharge and abstraction (in 89% RBDs), significant damage to groundwater dependent terrestrial ecosystems (in 71% RBDs) and saline or other intrusion (in 69% RBDs) were reported as considered in the assessment.

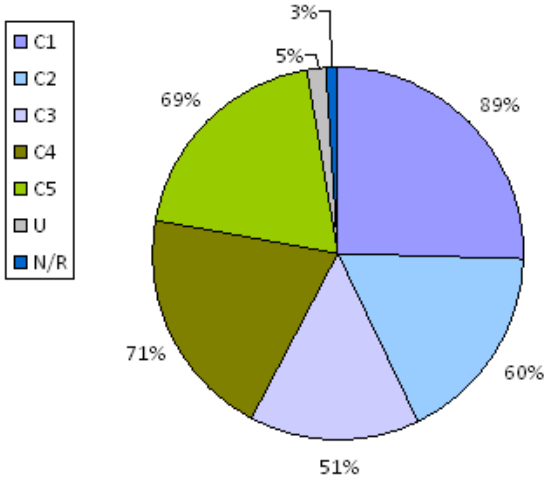
gives an overview of how often these criteria were explicitly reported to be considered in the status assessment (119 of 135 RBDs have been included in this assessment)

Table 5.1 Criteria (reported to be) considered within the assessment of groundwater quantitative status

# of RBD	Considered criteria
106	C1. The available groundwater resource is not exceeded by the long term annual average rate of abstraction
71	C2. Failure to achieve the environmental objectives specified under Article 4 for associated surface water bodies resulting from anthropogenic water level alteration or change in flow conditions
61	C3. Significant diminution in the status of surface waters resulting from anthropogenic water level alteration or change in flow conditions
84	C4. Significant damage to groundwater dependent terrestrial ecosystems resulting from an anthropogenic water level alteration
82	C5. Saline or other intrusions resulting from anthropogenically induced sustained changes in flow direction
6	U. Unclear
4	C7. No criteria reported
119	**Total number of analyzed RBDs**
135	**Total number of RBDs where data were uploaded to WISE**

Figure 5.3 – Percent of RBDs considering each of the criteria of WFD for assessing their groundwater quantitative status

Data source:WISE-WFD database February 2012



Regarding the application of the 'Available groundwater resource' this is defined in WFD Article 2.27 as the long-term annual average rate of overall recharge of the body of

groundwater less the long-term annual rate of flow required to achieve the ecological quality objectives for associated surface waters specified under Article 4, to avoid any significant diminution in the ecological status of such waters and to avoid any significant damage to associated terrestrial ecosystems. Half of the RBDs applied the term fully in line with the WFD requirement, 8% applied it partly, and for 42% of the RBDs (43 of 103) it was not clear or information was not given in the RBMPs. Furthermore, regarding the assessment of balance between recharge and abstraction, 33% of the RBDs reported that a comparison of annual average groundwater abstraction against 'available groundwater resource' has been calculated for every groundwater body, 24% reported that the comparison was made for a subset of Groundwater bodies, while for the majority of RBDs (43%) it was unclear or no such information was described in the RBMPs.

5.2. Comparison of the groundwater status in 2009 and 2015

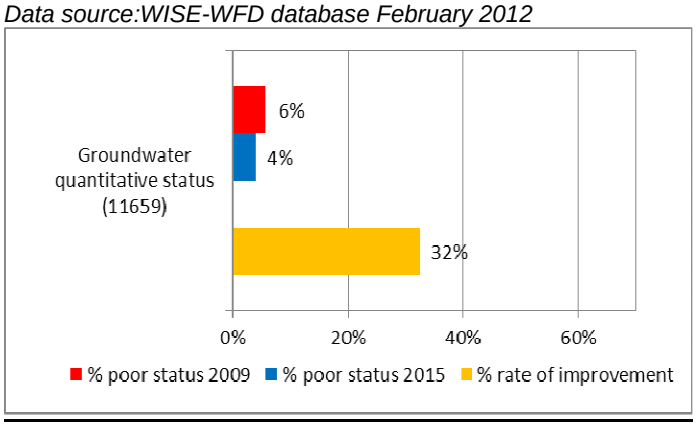
The potential groundwater quantitative status in 2015 was retrieved from the reported exemptions where Member states were required to indicate all bodies not achieving good status in 2015 after the necessary measures have been implemented, while justifying the request for and type of exemptions. All groundwater bodies without reported exemptions were considered to be in good status 2015.

The numbers of groundwater bodies with exemption(s) were compared with classified groundwater bodies and improved water bodies with water bodies in less than good status 2009 (rate of improvement). One water body can have more types and justifications of exemptions, but each water body was counted only once for the status results. Water bodies in good or unknown status in 2009 and with exemption in 2015 were excluded from the number of water bodies not achieving good status in 2015.

Overall, while 6% of the Groundwater bodies was reported to be in poor quantitative status in 2009, the analysis concluded that 4% of them will be in poor status in 2012, thus 2% of the Groundwater bodies are to improve their status from poor to good. In 11 RBDs total (in Italy, Spain, France) more than 10% of their Groundwater bodies is improving from poor status, in 5 RBDs (in Italy, Spain, France, Slovakia) 5-10% of their Groundwater bodies is improving from poor status, and in 11 RBDs (in Italy, France, United Kingdom, Czech Republic, Germany, Finland, Sweden, Ireland) less than 5% of their Groundwater bodies is improving from poor status in 2015. Significant improvement is expected in Quadalquivir, Andalusia Mediterranean Basins, Segura, Jucar, Catalan, Balearic Islands RBDs in Spain, Le Rhône, La Corse, L'Adour-Garonne-Dordogne RBDs in France, Po, North Appennines, Central Appennines in Italy, Danube in Slovakia, Scotland in United Kingdom and South Baltic Sea in Sweden.

Figure 5.4 – Comparison of the change of Groundwater bodies with poor quantitative status between 2009 and 2015

Data source:WISE-WFD database February 2012



Map 5.2 – Comparison of GWBs quantitative status between 2009 and 2015

Data source:WISE-WFD database February 2012

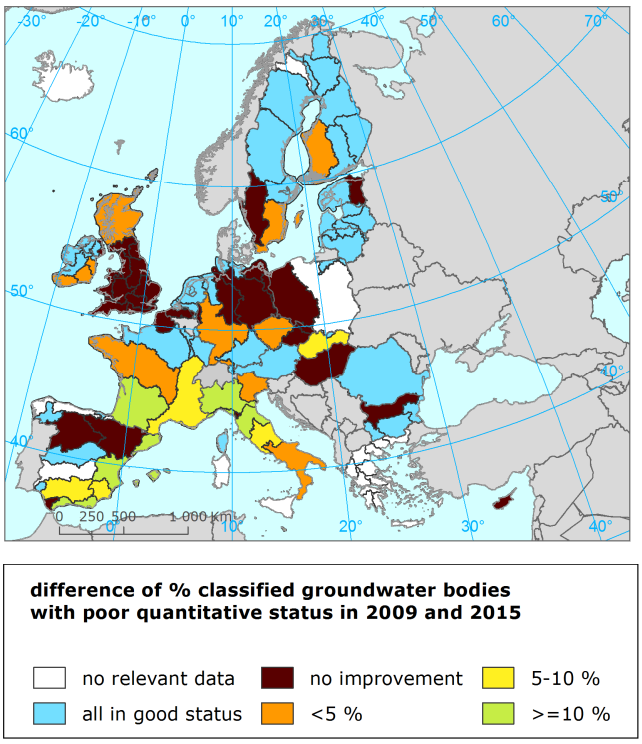
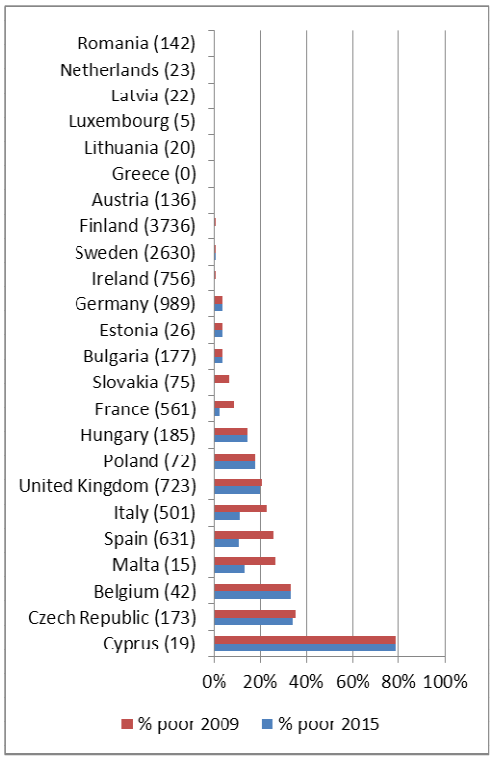


Figure 5.5 - Comparison of GWBs quantitative status between 2009 and 2015 per Member State

* Number in brackets indicate the number of Groundwater bodies

Data source:WISE-WFD database February 2012



5.3. Exemptions applied for reaching good groundwater quantitative status

For one third of the RBDs (46 out of 135) Members States applied for exemptions for not reaching good quantitative status, either by extending the deadlines or by achieving less stringent objectives (Table 5.2). Out of the 46 RBDs, 50% applied for extension of deadline due to technical feasibility, 43% applied for extension of deadline due to disproportionate cost, 37% applied for extension of deadline due to natural conditions, 26% applied for less stringent objectives due to technical feasibility, and 17% applied for less stringent objectives due to disproportionate cost.

The Member States that applied almost exclusively for extended deadlines are Belgium, Cyprus, Czech Republic, Spain, France, Sweden, Hungary and the United Kingdom. The MSs that applied almost exclusively for less stringent objectives are Bulgaria, Estonia and Poland. Finally, Germany, Italy and Malta applied almost equally for both types of exemptions (Figure 5.6). Regarding the justification of the exemptions, Bulgaria, Cyprus, Czech Republic, Estonia, Malta and Poland claimed technical feasibility issues, Belgium and Sweden referred to natural prevailing conditions, United Kingdom claimed disproportional costs, while Germany, Spain, France, Italy and Hungary claimed of mixture of the three justifications (Figure 5.7).

Table 5.2 - Exemptions applied for reaching good quantitative status (number of RBDs concerned).

# of RBD	Exemptions
23	Article4(4) – Extension of deadline – Technical feasibility
20	Article4(4) – Extension of deadline – Disproportionate cost
17	Article4(4) – Extension of deadline – Natural conditions
12	Article4(5) – Less stringent objectives – Technical feasibility
8	Article4(5) – Less stringent objectives – Disproportionate cost
46	**Total number of RBDs where exemptions were reported**
135	**Total number of RBDs where data were uploaded to WISE**

Figure 5.6 – Type of exemptions per Member State

* Number in brackets indicate the number of GWBs

Data source:WISE-WFD database February 2012

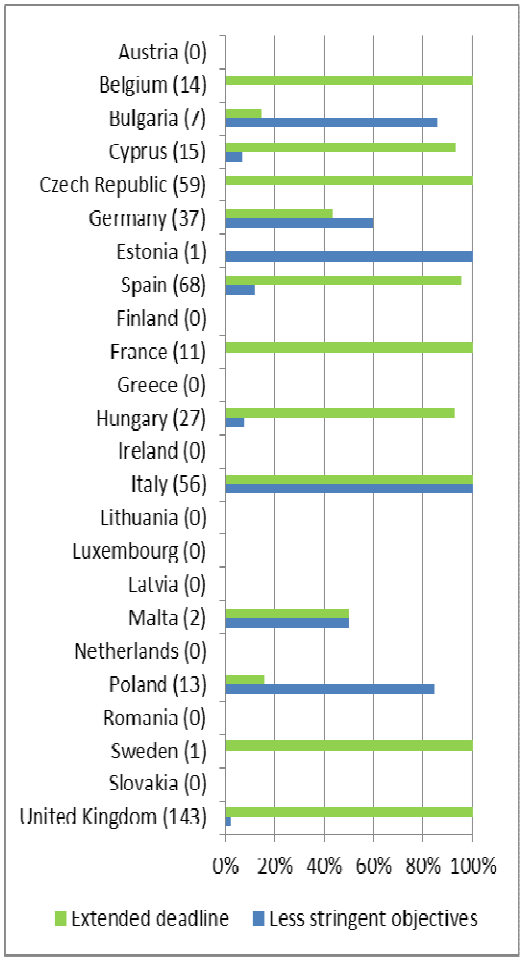
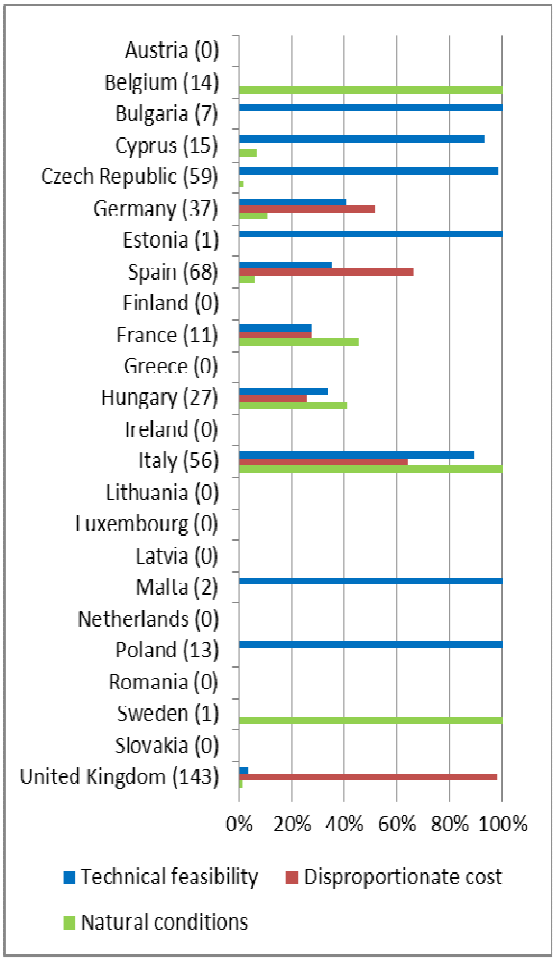


Figure 5.7 – Justification of exemptions per Member State

* Number in brackets indicate the number of GWBs

Data source:WISE-WFD database February 2012



6. Pressures

6.1. Overview of the pressures

Overall, 9843 Groundwater bodies (84%) are not affected by relevant pressures whereas 1816 groundwater bodies are affected from pressures upon groundwater quantitative status.

On the other hand groundwater bodies with poor quantitative status are affected by 86% (578 Groundwater bodies) from the relevant pressures whereas only 14% (94 Groundwater bodies) are not classified as been affected from relevant pressures.

Figure 6.1 – Relevant pressures for all classified GWBs

Data source:WISE-WFD database February 2012

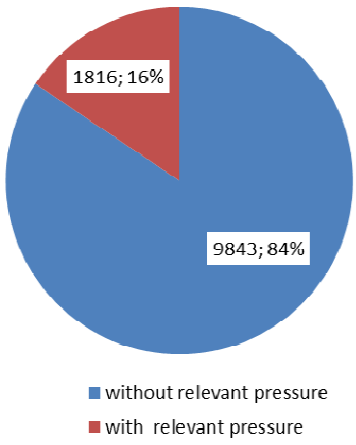
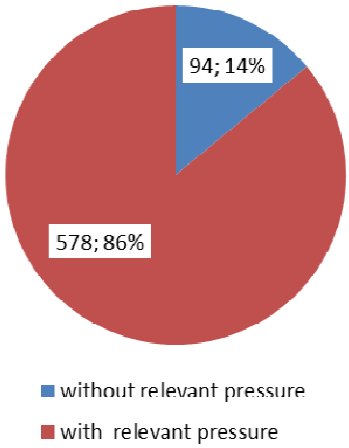


Figure 6.2 – Relevant pressures for GWBs in poor quantitative status

Data source:WISE-WFD database February 2012



There are four significant pressures that are affecting groundwater quantitative status. These are water abstraction, saline or other intrusion, artificial recharge and other pressures that are mainly relative to chemical pressures.

The most commonly reported pressures are water abstractions which constitute 11% of classified Groundwater bodies and 80% of Groundwater bodies which are in poor quantitative status. Saltwater intrusions comprise for 18 % of Groundwater bodies in poor status, artificial recharges with a very small percentage around 1% for Groundwater bodies in poor status and finally other pressures are responsible for about 5% of the Groundwater bodies in poor quantitative status.

Figure 6.3 – Relevant pressures for all classified GWBs

Data source:WISE-WFD database February 2012

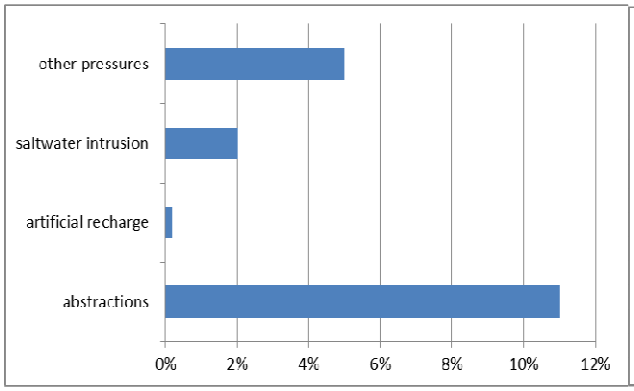


Figure 6.4 – Relevant pressures for GWBs in poor quantitative status

Data source:WISE-WFD database February 2012

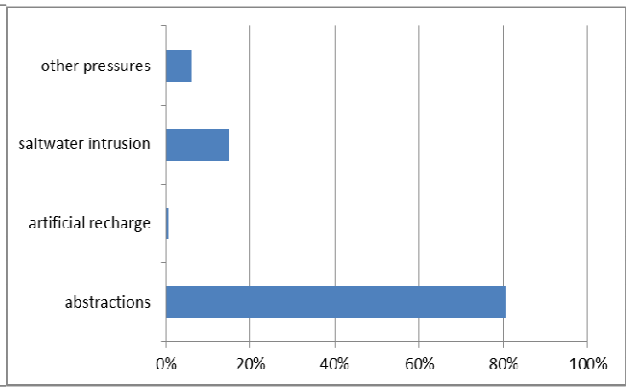
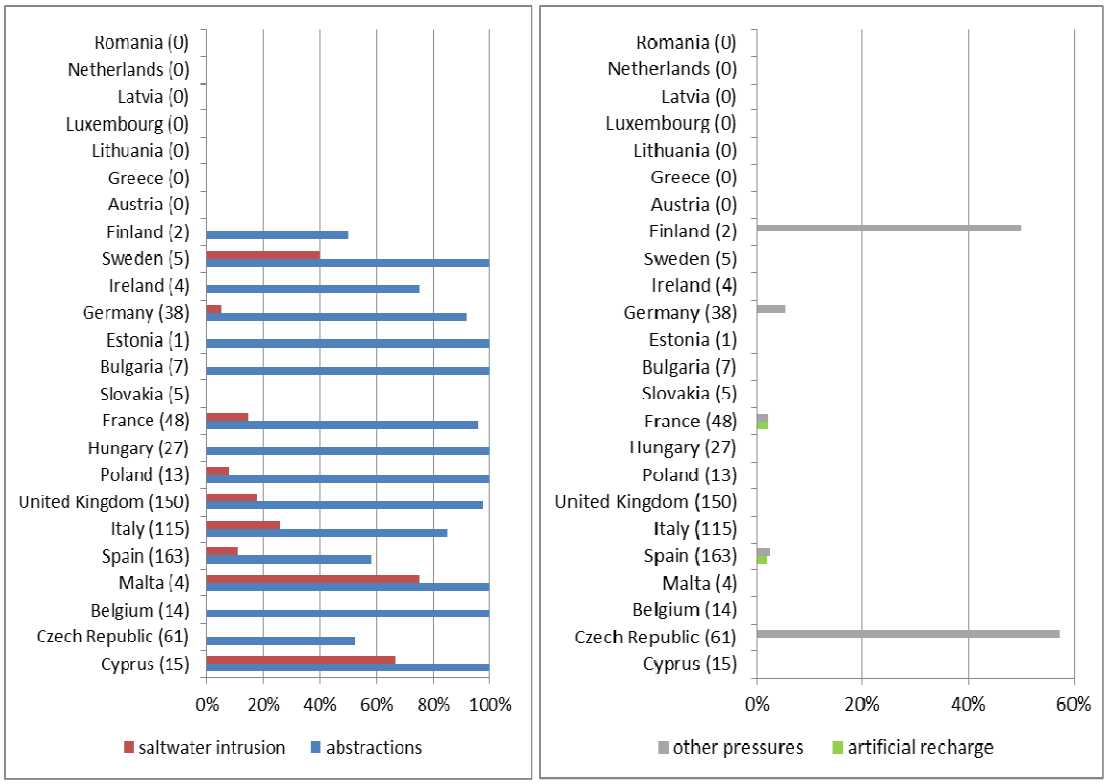


Figure 6.5 is showing the proportion of the 4 relevant pressures upon groundwater for groundwater bodies in poor quantitative status. Abstractions are the main pressure upon Groundwater bodies with most countries reaching 80-100% of their Groundwater bodies in poor status been affected. These countries are Sweden, Estonia, Bulgaria, Hungary, Poland, Malta, Belgium, Cyprus, Germany, France, United Kingdom and Italy. Ireland is affected 60-80% from abstractions whereas Finland, Czech Republic and Finland 40-60%. Saltwater Intrusion is the second most significant pressure affecting groundwater bodies as mentioned above and is mainly have an effect on Cyprus and Malta with a percentage from 60-80%. Less influenced are Sweden and Italy with number of groundwater bodies affected from 20-40%. Finally, countries that the number of their groundwater bodies were affected from 0-20% are Germany, France, United Kingdom and Spain. Artificial recharge is only affecting France and Spain with a very insignificant percentage upon groundwater bodies in poor status of approximately 2%. At last, other pressures (which are probably related to chemical pressures) are affecting Finland and Czech Republic of about 40-60% of groundwater bodies in poor quantitative status. In Germany, France and Spain are only less that 5% of their groundwater bodies are affected from other pressures.

Figure 6.5 – Proportion of relevant pressures for Groundwater bodies in poor quantitative status

Data source:WISE-WFD database February 2012



Note: Numbers in brackets indicate groundwater bodies in poor status. Countries are ranked by the percentage of water bodies not achieving good status.

Figure 6.6 – Relevant pressures for all classified water bodies

Data source:WISE-WFD database February 2012

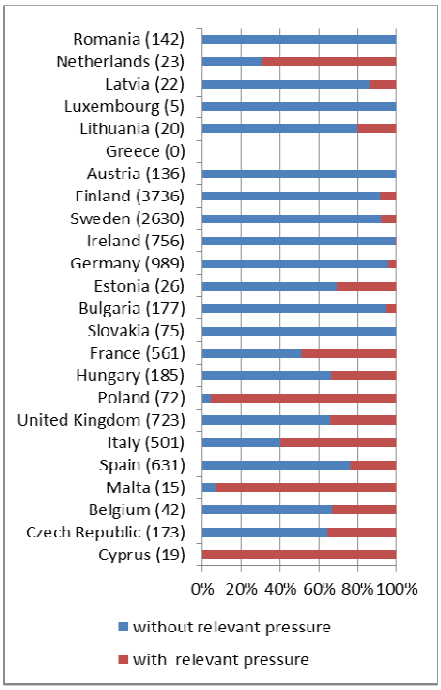
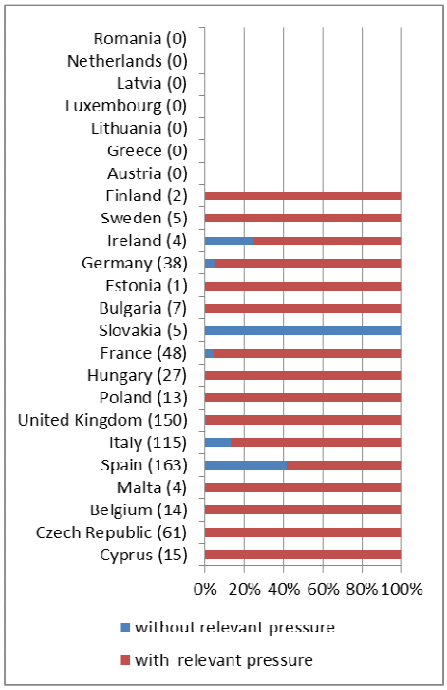


Figure 6.7 – Relevant pressures for Groundwater Bodies in poor status

Data source:WISE-WFD database February 2012



Notes: The number of all groundwater bodies (Groundwater quantitative status); classified groundwater bodies (Relevant pressures for all classified GWBs) or groundwater bodies with poor quantitative status (Relevant pressures for GWBs in poor status) is given in brackets for each member state. Empty rows in the pressures plots mean that no data on pressures are reported from those member states. "Relevant pressures" denotes the combination of the aggregated pressure types " abstractions"," saltwater intrusion", „artificial recharge" and „others pressures". . Artificial recharge and other pressures may not be the reason for not achieving good quantitative status – they can be linked to chemical status. Greece reported all GWBs with unknown status, RO, NL, LV, LU, and LT reported no GWBs in poor quantitative status. Countries are ranked by the percentage of water bodies not achieving good status.

6.2. Reasons for failing good quantitative status

There are five reasons for failing good quantitative status and are summarised in the Table 6.1 below.

About 40% of the RBDs (43% = 57 of 135 reported RBDs), where information is available are failing good quantitative status of groundwater bodies.

The main reason for failing good quantitative status is the exceedance of the available groundwater resource by the long-term annual average rate of abstraction that may result in a decrease of groundwater levels.

Table 6.1 - Reasons for failing good quantitative status (number of RBDs concerned)

RBD	Reasons for failing good groundwater quantitative status
49	a) Exceedance of available groundwater resource by long-term annual average rate of abstraction that may result in a decrease of groundwater levels
18	b) Failure to achieve environmental objectives (Article 4 WFD) for associated surface waters;
23	c) Significant diminution of the status of surface waters;
9	d) Significant damage to terrestrial ecosystems directly depending on groundwater;
14	e) Saline or other intrusion
57	**Total number of RBDs where poor status is evident and reasons were reported**
135	**Total number of RBDs where data were uploaded to WISE**

6.3. Groundwater dependent terrestrial ecosystems (GWDTE)

For a Groundwater body to be of good status there should be no significant damage to a terrestrial ecosystem that depends on groundwater. From the groundwater bodies that were analyzed in this respect it was found that:

- From one third of the RBDs (45 of 135) groundwater dependent terrestrial ecosystems were reported.
- In one third (35) of the 119 RBDs which were assessed in detail, groundwater dependent terrestrial ecosystems were reported. In 19 RBMPs the needs of the Groundwater dependent terrestrial ecosystems were reported to be considered within the status assessment, and in 11 RBMPs it was not explicitly reported that their needs were to be considered.
- About 71% of the assessed RBDs (84 of 119) considered Groundwater dependent terrestrial ecosystems in the status assessment, although only 20% (21 RBDs) reported Groundwater dependent terrestrial ecosystems.
- Damage to Groundwater dependent terrestrial ecosystems as reason for poor groundwater quantitative status was reported by nine of the 119 RBDs which were assessed in detail.

6.4. Saline or other intrusion

For a Groundwater body to be of good status it should be no long-term intrusion of saline (or other poor quality water) resulting from anthropogenically induced sustained water level or head change, reduction in flow or alteration of flow direction due to abstraction.

- About 69% of the RBDs (82 of 119) considered saline or other intrusion in the status assessment, but only 29 of them reported it as significant pressure.
- Nearly all (22) of the 29 RBDs which reported saline intrusion as significant pressure reported that they considered it in the status assessment.

7. Measures related to groundwater quantitative status

The measures that were identified in the WISE-WFD database as well as in the compliance check database were grouped into 11 categories and are outlined below:

1. Promote and increase water use efficiency
2. Controls over groundwater abstraction - including registers of abstractions and requirement for prior authorisation of abstractions
3. Controls of artificial recharge or augmentation of groundwater bodies - including a requirement for prior authorisation
4. Monitoring: abstractions (installation of meters), piezometric levels
5. Investment in water saving irrigation techniques
6. Management plans
7. Awareness raising//advise/education
8. (waste) water re-use and rain water management
9. Artificial recharge (Increase resources by e.g. desalination)
10. Science/Research/Risk and vulnerability Assessments
11. financial incentives / pricing policy for sustainable use (charges/fines/taxes for GW abstractions)

The measures outlined above were compiled from analyzing those RBDs that in 2009 were in poor quantitative status but the projections for 2015 are showing significant improvement. Table 7.1 lists the RBDs under assessment and the percentage of improvement in their status from 2009-2015. The main countries showing significant improvement are Spain, France and Italy.

Table 7.1 – % of quantitative improvement 2009-2015 (poor status RBDs)

RBDs	poor 09	poor 15	2009-2015	No. of improved GWBs
ES050	35.0%	28.3%	6.67%	4
ES060	46.3%	0.0%	46.27%	31
ES070	69.8%	63.5%	6.35%	4
ES080	37.8%	0.0%	37.78%	34
ES100	15.4%	5.1%	10.26%	4
ES110	20.0%	0.0%	20.00%	18
FRD	8.9%	0.0%	8.89%	16
FRF	17.1%	4.8%	12.38%	13
FRG	7.0%	2.1%	4.90%	7
ITB	19.1%	0.0%	19.15%	27
ITC	26.9%	14.0%	12.90%	24

ITE	15.0%	12.0%	3.01%	4
SE4	0.7%	0.0%	0.69%	4
SK40000	5.2%	0.0%	5.15%	5
UK01	12.0%	9.5%	2.46%	7

Table 7.2 shows the number of RBDs where the measure was applied as well as the percentage according to the RBDs that were under investigation. From the results it can be noticed that for the first three measures (water efficiency, control over groundwater abstraction and control of artificial recharge) 100% of the time the measure was applied. In 12 out of 15 RBDs (80% of the time) Monitoring of abstractions measure is applied. The rest of the measures are applied approximately 50% of the time with an exception of measure 11 with only 2 RBDs considering it in their measure plan.

Table 7.2 – Group of measures and % of measures used from 15 RBDs

No	**Measures**	**Number of RBDs -applied measure**	**% of measure applied**
1	Promote and increase water use efficiency	15	100
2	Controls over groundwater abstraction - including registers of abstractions and requirement for prior authorisation of abstractions	15	100
3	Controls of artificial recharge or augmentation of groundwater bodies - including a requirement for prior authorisation	15	100
4	Monitoring: abstractions (installation of meters), piezometric levels	12	80
5	Investment in water saving irrigation techniques	8	53
6	Management plans	8	53
7	Awareness raising//advise/education	7	47
8	(waste) water re-use and rain water management	7	47
9	Artificial recharge (Increase resources by e.g. desalination)	6	40
10	Science/Research/Risk and vulnerability Assessments	6	40
11	financial incentives / pricing policy for sustainable use (charges/fines/taxes for GW abstractions)	2	13

It is very important to mention that in the overall assessment, several countries just refer to laws or guidelines where the detailed measures are described. This means that the overall table with the measures per RBD is not complete. From this assessment it has to be distinct that the measures that the Member states intend to take and included in their program of

measures do not guarantee the effectiveness of these measures as they will be assessed in 2015.

8. Case studies

Netherlands

The Netherlands rely by 60% on groundwater for drinking water supply and 100% in dry periods for irrigation needs (NWP. 2007). Despite this increased reliance of the Dutch water sector to groundwater resources, groundwater bodies were reported to have a good quantitative status in all four Dutch River Basin Management Plans. The country's main response to decreasing groundwater resources is the recharge of river water in dune infiltration ponds and wells. This measure has been in place for the past 50 years for securing drinking water supply to Amsterdam, The Hague and many other cities (NWP. 2007).

In the water management district "Waterschap Groot Salland" (82,000 ha) located in the Dutch part of the Rhine river basin, the quantitative status of two groundwater bodies was assessed with the use of four tests : water balance, saline intrusion, aquatic ecosystems and terrestrial ecosystems.

In these water bodies are situated two major groundwater dependent terrestrial ecosystems, designated as Natura 2000 sites, the 'Boetelerveld' (173 ha) and the 'Olde Maten and Veerslootlanden' (993 ha). These natural ecosystems mainly consist of marshland, the development of which is due to the impermeable layers of underground geologic formations that block the drainage and form wet land.

The research on the quantitative status of the two Groundwater bodies led to the following conclusions:

- In terms of water balance the good status of the Groundwater bodies is not affected because of a surplus of net precipitation.
- Salt water intrusion in the Groundwater bodies is controlled and thus prevented by permanent 'early warning' monitoring systems and therefore does not affect the good status of the Groundwater bodies.
- The surface water bodies in the Groot Salland district, mainly man made watercourses for purposes of drainage and flood protection, were formed during the 1960s and 1970s and their ecological objectives (MEP/GEP) are determined by the quality of the Rhine water led in during dry periods. Thus, the quality of surface waters in the area is not significantly dependent on the supply of groundwater and so the good status of the Groundwater bodies is not affected.
- In both groundwater dependent terrestrial ecosystems measures in order to raise the groundwater table have been taken, e.g. the filling of the ditches and the construction of a canal in 2000 with high water level in the Boetelerveld in order to retain more

precipitation. It was confirmed that drinking water abstractions elsewhere in the Groundwater bodies did not have an important influence on the groundwater table in these two Natura 2000 areas. Concluding, since 2000, when the WFD came into force, the hydrological conditions in the two areas remain stable and are considered to be sufficient for preserving the two Groundwater bodies in a good status.

Spain

Catalonia is divided in two river basin districts which include a total of 53 groundwater bodies. According to the Catalan Water Agency, 21% of groundwater bodies are at risk of non-compliance with the Directive objectives for groundwater quantitative status. These groundwater bodies are mainly affected by overexploitation for domestic public water supply in densely populated areas. This overexploitation creates an imbalance between the available and required water and allows saline intrusion in many groundwater bodies of the region. For addressing this issue, the Catalan Water Agency promotes the substitution of groundwater abstraction with other sources, such as water discharged from tertiary waste water treatment plants and desalination plants. In addition, the Catalan Water Agency is also considering the use of treated and desalinated water for artificially recharging groundwater bodies. This response has reversed the effect of overexploitation in the two pilot groundwater bodies where it was implemented. (Ninerola and Ortuno, 2008).

Italy

The reported River Basin Management Plans, for Italy's six River Basin Districts, identified that 53% present a good quantitative status, 16% a poor quantitative status and the status is unknown for the remaining 31% of Italy's groundwater bodies. Italy's groundwater bodies quantitative status is mainly caused by overexploitation, failure to achieve environemental objectives for surface waters and saline intrusion. Overexploitation of groundwater resources occurs mainly in the large urban areas of northern Italy, the tourist areas of the coasts of Romagna and Toscana, large industrial areas and densely cultivated areas such as the valley of the river Po. Italian authorities' main response to overexploitation is the monitoring of all groundwater abstractions and the prohibition of abstraction to all unmetered abstraction points. Furthermore, Italian authorities have initiated pilot programmes of groundwater recharge in areas of Piedmont and planned for areas in Toscana and promote the replacement of groundwater with re-used and treated water mainly for industrial and irrigation purposes (EASAC, 2010b).

9. Linking measures with PSI storyline

(Chapter to be drafted for final draft 15 June 2012)

10.Conclusions

The current report focuses on presenting and analyzing information around the quantitative status of the European Groundwater Bodies. The background information has been extracted from the WFD RBMPs. Based on the available data a series of graphs has been produced in order to cross-compare and assess the prevailing issues in relation to the quantitative status.

The results from the quantitative status assessment shows that only a few countries, namely Spain, United Kingdom, Belgium, Czech Republic, Germany, Italy, Malta, have groundwater quantitative problems which are though mainly found in specific RBDs and not in the whole country, with the exception of Cyprus where approximately 70% of its Groundwater bodies are in poor status.

The report also goes through the significant pressures that are posed upon the groundwater bodies (groundwater abstraction, saltwater intrusion, artificial recharge and other pressures that are mostly relevant with chemical pressures. Groundwater abstractions are the main pressure that significantly influences Europe's groundwater bodies.

Moreover, the potential groundwater quantitative status in 2015 was retrieved from the reported exemptions where Member states were required to indicate all bodies not achieving good status in 2015 after the necessary measures have been implemented, while justifying the request for and type of exemptions. All groundwater bodies without reported exemptions were considered to be in good status 2015.

For one third of the RBDs (46 out of 135) Members States applied for exemptions for not reaching good quantitative status, either by extending the deadlines or by achieving less stringent objectives The reasons for failing good quantitative status was also assessed. About 40% of the RBDs (43% = 57 of 135 reported RBDs), where information is available are failing good quantitative status of groundwater bodies.The main reason for that is the exceedance of the available groundwater resource by the long-term annual average rate of abstraction that may result in a decrease of groundwater levels.

Finally, an assessment of the measures that member states took in order to improve their quantitative status was assessed for those RBDs that were in poor quantitative status in 2009 and are significantly improving in 2015. From the assessment it was observed that member states are focusing on measures that will improve the main pressures (groundwater abstraction) by taking measures controlling groundwater abstraction and by increasing water use efficiency. On the other hand all 15 RBDs that where analysed have taken measures to

control artificial recharge or augmentation of groundwater bodies which is a pressure that from the quantitative assessment does not seem to cause significant problems to the countries.

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