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WATER MANAGEMENT PLANS FOR SLOVAKIAN-HUNGARIAN TRANSBOUNDARY GROUNDWATER BODIES: IPOLY VALLEY, BODROG REGION, AGGTELEKI- SLOVAKIAN KARST

1 Introduction

The present work is based on the service contract between Geological Institute of Hungary (MÁFI) and Geological Survey of Finland (GTK): Assigning Contract MÁFI project number 272 62 144: *Subsurface water management plans for subsurface water bodies divided by Slovakian-Hungarian border — the Ipoly Valley, the Aggtelek-Slovakian Karst, and the Bodrog Region — 3 studies.* The following data gathered by MÁFI and SGUDS together with the final results of the groundwater modelling work of SMARAGD-GSH formed a basis for GTK´s work:

- Characteristic water production data of groundwater used in regional models for the 2000-2005 period
- Location of significant presumed and known diffuse or local pollution sites;
- Information concerning regional models (concept, spatial location and hydrogeological characteristic of hydrostratigraphic units, recharge and discharge boundary conditions) outputs adequate to the completion level of model, that is calculated data on water budget, and on soil-, ground-, and karst-water level.
- Relevant results of the collected information and background studies during the fieldwork for modeling.
- Results of the complementary field observations, water-chemistry studies and water-chemical evaluations.
- Results of the concerning work of the Slovakian partner, and its data available in the frame of ENWAT project.

Furthermore, additional information necessary for the successful completion of GTK´s work was gathered during two fact-finding travels to the research areas both in Hungary and in Slovakia. Also the relevant EU directives, especially Water Framework Directive and Groundwater Directive, and EU guidelines related to water management and other environmental objectives were analysed and have been taken into account in compilation of the groundwater management plans. In addition, the recommendations of previous River Basin Management projects, e.g. Transboundary River Basin Management of the Körös/Crisuri River Project, The Tisza River Project and Zagyva-Tarna Project, have been taken into account.
The present report gives a comprehensive summary of the work carried out, methods used and experience gained. This was made to fully satisfy the needs of Water Framework Directive and related guidelines.

2 Objectives

The main objectives of GTK were to create water management plans for Slovakian-Hungarian transboundary groundwater bodies: Ipoly valley, Bodrog region and Aggtelek-Slovakian karst, applying the hydrogeological evaluation and the regional hydrogeological model of the transboundary subsurface water-body groups, for the given scenarios of water usage and environmental impacts:

- scenario I: Present or increased water usage under current climatic conditions.
- scenario II: Sustainable water usage considering the effects of global climate change, till 2050

During the creation of water management plans, the followings were evaluated:

- The trend of the relationship of surface and subsurface water, especially for ecosystems depending on subsurface waters;
- The effects influencing the current water usage and the future possibilities and limitations of water production;
- The effects influencing the chemical status of subsurface water, so that the present unfavourable influences could be stopped, that the expected adverse effects could be avoided, and that the necceserray actions could be formed;

River basin management plans were made to cover the elements defined in Annex VIII of the WFD so that they can support the creation of the WFD required action plans. For example, Programme of measures is presented based on the hydrogeological evaluations and regional models in order to optimally sustain water management. Besides the WFD requirements, also other relevant EU and national (Hungarian, Slovakian) regulations and legislations were considered.

The following groups of groundwater bodies were studied:

1. Groundwater bodies in the basin of Ipoly Valley and the related groundwater bodies hosted by Oligocene and Miocene mountainous areas and united by common recharge area.
2. Groundwater bodies on the area of Aggtelek - Slovakian Karst.
3. Groundwater bodies in the recharge area of Bodrog River, in Slovakia Quaternary alluvial sediments, in Hungary Quaternary and Pannonian alluvial and eolian sediments.

3 Underlying scenarios

The objective of this undertaking has been to compile water management plans, applying the hydrogeological evaluation and the regional hydrogeological model of the transboundary subsurface water-body groups, for the two scenarios of water usage and environmental impacts.

- 1. scenario: Present or increased water usage under current climatic conditions.
- 2. scenario: Sustainable water usage considering the effects of global climate change, till 2050

Today most central and north European countries including Hungary and Slovakia can be considered as non-water stressed (Nixon et al., 2003). The climate change processes are complex and to some extent contrasting so that site-specific trends will difficult to estimate.
Temperature and precipitation are the most important drivers for the water cycle and changes in these parameters are expected to have considerable impacts. During the last century, temperature has shown an increasing trend of 0.8−0.95 °C over Europe (EEA, 2004). Higher temperatures increase evaporation and thus lead more water vapor in the air, increasing the precipitation potential. However, precipitation strongly depends on regional circulation patterns, local topography, etc. thus it remains difficult to project its spatial distribution. Despite uncertainties about the degree of the projected changes, resulting from differences in climate models and unknown future development paths, there is a general agreement that the observed trends of climate changes are going to continue in the 21st century. Projections for 2100 anticipate that in the investigation areas the mean temperature is going to rise 1.0−4.5. °C depending on future greenhouse gas emissions (Figure 1).
The projected changes in temperature and precipitation could have severe impacts on river discharges and water resources availability. Higher temperatures in winter mean that less precipitation will be falling as snow and snowmelt will be occurring earlier, thus changing the seasonal time of river discharge. Winter precipitation for the largest part of Europe is expected to increase. Furthermore, due to changing snow melt dynamics at higher latitudes spring floods are expected to shift about 2 months earlier, therefore winter flood risks are likely to increase in western, north-eastern and eastern Europe. Summer precipitation is projected to decrease in southern, western and central Europe with drought periods becoming more common (Räisänen et al. 2004). The magnitude and frequency of extreme weather events are expected to increase, and hydrological extremes such as floods and droughts are likely to be more frequent and severe over Europe leading to higher environmental, ecological and socio-economic pressures and costs. Climate change will also strongly change variability of summer climates both for precipitation and temperature. Future climate in central Europe will also likely show stronger dependence on land-atmospheric coupling, and changes in the interactions between soil

moisture, temperature, wind intensity and solar radiation that control evapotranspiration (Seneviratne et al., 2006). A review of the impact estimates has been recently made by Dankers et al. 2007.

At the same time rising demand for water in agriculture and energy production sectors may further increase Europe's vulnerability in some regions. Climate change will not just affect water quantity; low water levels can have a negative impact on water quality by bringing physico-chemical and biological changes. Higher runoff will increase pollution from diffuse sources, (e.g. capacity overloads of urban sewer systems), further deteriorating water quality. On the other hand reduced water levels mean that pollutants will be less diluted.

However, concerning the Hungary-Slovakia transboundary areas overall water availability is projected to decrease although not as drastically as in south and south-eastern Europe, in general. Nevertheless, in the following, water management strategies needed to adapt to climate changes are distinguished at regional scales considering potential impacts in general.

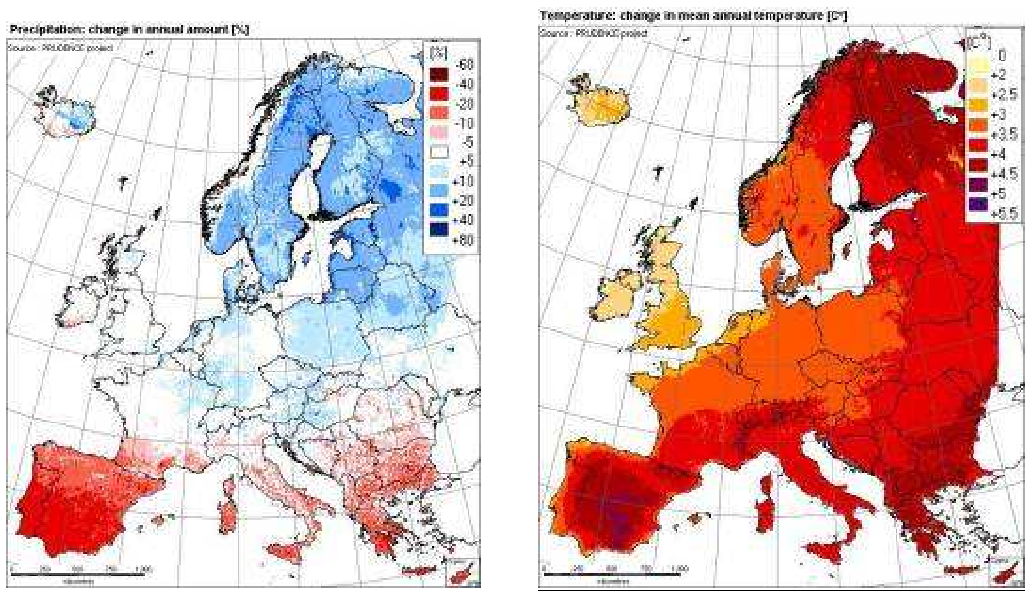

Figure 1. Relative change in mean annual precipitation and mean annual temperature between control period 1961-1990 and 2071-2100, under the IPCC SRES scenario A2 (source: Prudence project.

4 General remarks

As early steps of the WFD-implementation process, the characteristics of the river basin district and review of the environmental impact of human activity have already been carried out by the competent authorities. These studies have produced also tentative classifications concerning the status and possible risks of surface water and groundwater. In addition, projects such as ECOSURV carried out to support WFD-implementation in Hungary (Arcadis et al. 2006) also provided additional information on surface water composition and ecological stressors. In the to the ECOSURV project, physico-chemical parameters and the ecological indicators relevant for the surface water ecological and chemical status were analysed in Hungary. Some of them located also in the three study areas of ENWAT-project. For the assessment of the relationships between groundwater and surface water, it is important to realise that all of these areas included at least some sample points suggesting that the surface water status is not good as far as Phytoplankton, Macrophytes and general degradated and organic stressors for macro-invertebrates were concerned. The physico-chemical parameters measured in ECOSURV included also mineral nitrogen concentrations, which do not suggest good status for any of the studied subcatchments. A comprehensive classification of surface water bodies in Hungary by Hungarian Academy of Sciences, Water Resource Management Research Group is shown in Figure 2.

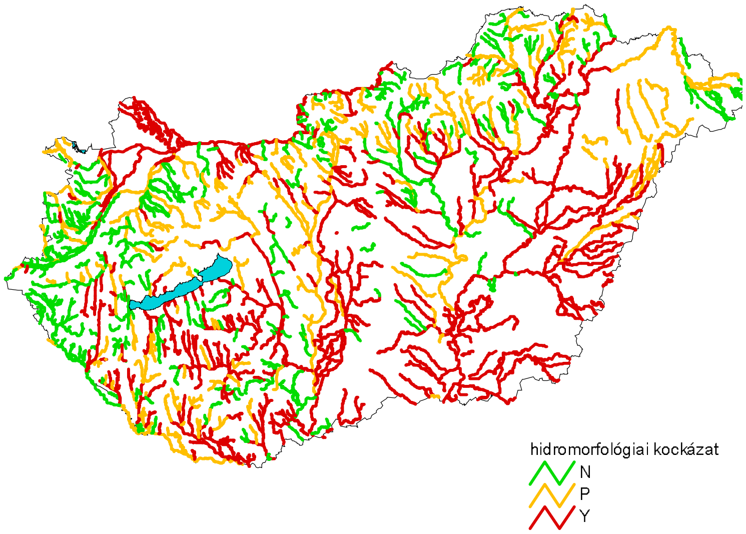

Figure 2. Risk classification of Hungarian rivers according to hydromorphological risk by Hungarian Academy of Sciences, Research Group for Water Resource Management. The classification has been done pursuant to the Water Framework Directive. Green: good hydromophological conditions and water body is not at risk; Orange: potential impacts on hydromorphological conditions and water body is potentially at risk; and Red: existing impacts on conditions and water body is at risk of failing the environmental objectives.

The delineation of water bodies will be finalized for based on available data in 2008 for the first River Basin Management Plans which will be due by 2009. After that the water body boundaries will be fixed for the rest of the planning period. Therefore, this report has been prepared in conditions when groundwater body delineations are in progress.

The status of a water body as defined in Water Framework Directive (WFD)/Groundwater Directive (GWD) is a characteristic of a whole water body. The assessment of status should be carried out based on comprehensive analysis of the information available for the whole water body. The limitations of available data and the ongoing implementation of the WFD/GWD have been taken into account also when discussing the status of groundwater. The final classification of the surface water bodies in the study areas directly associated with groundwater bodies can have important implications on the classification of the chemical status of groundwater bodies. Furthermore, other investigations besides ENWAT may provide information that affects the definition of chemical status for groundwater bodies.

According to WFD, if the concentrations in groundwater are such that an the Environmental Objectives for the associated surface waters are will not be achieved or leads to any significant diminution of the ecological or chemical quality of such bodies. In such a case the status of groundwater body can be poor, even if even when water quality problems do not consider the whole groundwater body. However, clarifications given by GWD (Article 4) describe the procedures that can be applied alternatively to define groundwater chemical status if appropriate investigations have been carried out. These may be used to target more specific actions to problem areas instead of applying groundwater-body scale actions.

Although substantial amounts of new data have been collected in ENWAT-project, they may not be representative for the whole water bodies in the investigation areas. Therefore, the following is not a review of previous classifications or attempt to draft the actual River Basin Management Plans. Instead, the following analysis is rather an expert opinion of the relevance of the data for the different aspects of WFD/GWD-implementation. Estimates made by the project partners on the groundwater and surface water interactions and their implications to the attainment of good chemical status for the groundwater bodies in the study areas as discussed below.

5 The relations ships of surface and subsurface water bodies

5.1 Bodrog area

In addition to the samples collected in 12 points, data compiled in Slovakia for the project includes results of the Slovakian natural water quality mapping program, hydrogeological map of the Medzibodrožie region and studies of geological factors controlling groundwater (Jetel et al., 2000). In Slovakia analyses from 135 locations were available.

The Hungarian data comprised e.g. 553 nitrate analyses taken in different locations at different times. Some of the data values in Hungary are substantially old being taken in 30'ies. Therefore, the most of the data rather comprises single analyses than systematic regional sampling campaigns. The samples collected in ENWAT represent additional sample points that were collected in risk areas in order to complement conceptual understanding of the pollution situation.

The recharge of groundwater in the Quaternary deposits takes place by direct recharge from precipitation, inflow of groundwater from Neogene aquifer and surrounding geological units and in the high elevation areas as infiltration from Bodrog river and foothill streams. Precipitation ranging 540-660 mm/year carries in some extent pollutants into groundwater system near industrial zones. In addition, in those areas especially, winter precipitation is acidic with relatively low pH and high NH_4^+ contents.

The low land areas between Bodrog and Tisza Rivers act as discharge areas of the regional groundwater flow. Based on soil moisture balance calculations, in these areas estimated infiltration of precipitation ranging 0-22 mm/year is substantially lower that the estimated evapotranspiration exceeding 220 mm/year and having effective depth ranging 1-1.4 m. The estimates are based on hydrological HELP-modelling carried out in the ENWAT-project (Smaragd, 2008). These results suggest that already in the present climatic conditions evapotranspiration effects strongly concentrations in shallow groundwater and that these phenomena will be significantly enhanced due to climate change.

Based on Slovakian data, concentrations of Cl- and TDS in groundwater are commonly range 100-200 mg/l and 500-1500 mg/l , respectively, in shallow groundwater in depths 0-20 m below ground surface. In Hungarian data the maximum concentrations are similar but the average concentrations are substantially lower. Similarly, the average nitrate concentrations are in Hungarian and Slovakian parts of the study area are about 4.8 mg/l and 135.5 mg/l respectively.

The differences may result from relatively intense industrial pollution in Slovakia. Based on monitoring that has been continued since 1976, the industrial airborne pollution over 50 % of the localities in the Bodrog region receive higher concentrations of the main analytical components compared to the Slovak average values. The main cations are Ca^{2+}, NH^{4+} and dominant anions are Na^+ as and SO_4^{2-} , NO_3^- and Cl^-. The spatial variability of chemical contents is significant e.g. TDS (8,17 – 179,2 mg.l-1) and pH (3,72 – 9,34) (Kordik et al. 2007a).

Besides more intense in airborne industrial pollution in Slovakia, the lower TDS, Cl^- and NO_3^- results may also reflect the more extensive discharge of (dilute) groundwater from the deeper parts of the regional flow systems at the Hungarian part of the study area or infiltration of more dilute surface waters during e.g. spring floods in the shallow parts of the aquifers (see Figure 3).

In despite of lower average concentrations compared to Slovakian data, also the Hungarian data includes high measured nitrate concentrations particularly in association with potential pollution sources such as rural settlements, and dumps sites. Highest values in Hungarian part of the study area exceed the quality standard several to couple of hundred times. The analysis of the pollution situation appears to require an analysis similar to the one carried out by SGUDS for this project (Kordik et al. 2007a) or a more thorough review of the data.

In general, a substantial part of their run-off of the Bodrog and Tisza River i.e. the base flow is formed by discharge of groundwater through the Quaternary deposits. The study area include also protected Bodrok National Park established essentially on a flooding area at the Bodrog-Tisza River junctions and consequently, the ecology of which are closely associated with these rivers. Furthermore, important environmentally sensitive areas and NRDP-pilot areas comprise an essential part of the Bodrog river catchment in Hungary. In the previous studies, the surface water ecology is concluded to suffer at least a risk of diminution of the ecological or chemical quality (parts of Tisza River) or due to nutrient loads (nitrogen) and also possible organics (Bodrog and a part of Tisza River). Furthermore, concentrations close to the quality limit are found in deeper parts of the Quaternary deposits (depths exceeding 20 m bgs) based on Hungarian data indicating also that nitrate polluted upper parts can be hydraulically connected to deeper parts of Quaternary deposits. In most cases, the data does not allow without further investigations to distinguish if the connection can be due natural flow process of due to well damages.

In general, Slovakian monitoring data probably address shallower groundwater conditions subject to the influence of evapotranspiration compared to the available Hungarian data. Furthermore, the results of groundwater quality studies in Slovakia are consistent with the Hungarian studies of biological indicators of surface water status and nitrate concentrations (Arcadis 2006; Hungarian Academy of Sciences, see Figure 2) and previous classifications of surface water qualities made in Slovakia (Kordik et al., 2007b). The average concentrations in wells in Quaternary deposits exceed the 50 mg/l quality standard for nitrates in Slovakia although most severe pollution concerns mostly the shallow Quaternary layers (0-20 m bgs). Therefore, the main anthropogenic components with significantly increased concentrations can be considered to include NO_3^-, NH_4^+, NO_2^-, Cl-, SO_4^{2-}, Fe^{3+}, Mn^{2+}, TDS, Al^{3+}, CODMn also for the complete study area. In addition based on relatively scarce data some organic parameters (PAH, oil products) are present in the area. The sources of pollution based on the conceptual and geochemical modelling carried out in both countries is predominantly agricultural activities but also industry and waste water production comprise significant sources.

As discussed in more detail below, due to the relatively high TDS and Cl- concentrations in shallow groundwater, characteristic to Slovakia part of the study area, the future management of water resources should pay attention to the potential impacts under the warming climate increasing evaporation.

Therefore, it seems that particularly in the shallow parts of the Bodrog area, chemical composition of the groundwater discharging into surface water bodies and to groundwater dependent terrestrial ecosystems in protected areas could cause failure to achieve the Environmental Objectives for associated surface waters or diminution of the ecological or chemical quality of such bodies or a significant damage to terrestrial ecosystems which depend directly on the groundwater body. Therefore, here a conservative suggestion is made that in implementation of WFD, the chemical status of groundwater in the Quaternary deposits in the Bodrog area should be considered to be not good and strongly effected by human activities. However, it should be addressed that the data does not allow any estimates of the significance of denitrification and biodegradation of organic pollutants below the most polluted shallow parts. The potential effects of the denitrification and biodegradation on the pollution trend will be discussed below.

Measures to be suggested for Bodrog area should include not only the Basic measures but also the Supplementary measures according to WFD. These should consider both point sources such as sites were sewage leachates and waste waters infiltrate into subsurface, and diffuse sources such as agricultural areas, irrespective if there is an upward trend in nitrates (or other pollutants) or not. Also appropriate investigations pursuant to the Article 4 and Annex II of the Groundwater Directive should be completed. These studies should be carried out in Hungarian-Slovakian co-operation between competent authorities and expert organizations.

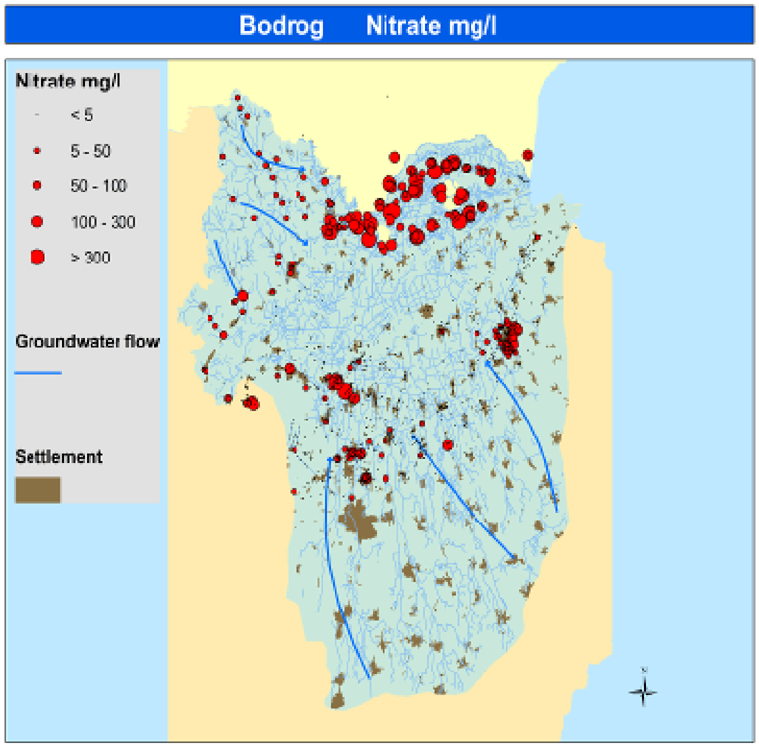

Figure 3. Nitrate concentrations in boreholes in the Bodrog-area. The blue arrows indicate the regional groundwater flow directions. Locations of settlements (brown) and numerous channels and streams into which groundwater is discharged are indicated on the background (semitransparent blue lines).

5.2 Aggleteki - Slovakian karst area

The previous invetigations by SGUD for the ENWAT –project an assessment of natural background values, suggestions for threshold values and hydrogeochemical conditions (Kordik et al., 2007b, c). In the Hungarian side the ENWAT database includes over 92 routine water samples taken 2005-2007 and 3329 samples in total.

The Hungarian studies of surface water quality and status have suggested ecological stressors (Arcadis, 2006) and according to Hungarian Academy of Sciences, hydromorphological status for some of the river braches in the area has been considered to be at risk. Several of the river branches have been also considered heavily modified largely due to the flood prevention actions that have involved straightening of the flow channels and construction of canals and dikes. The area is a good example of results of mutually non integrated river management actions. Flood prevention activities have been initiated already in the last century when flooding of the rivers became critically worsened subsequent to claiming wetlands and draining of headwater areas for agriculture in general. This triggered a gradually worsening and shifting process where channels moved fast the water down current to new areas which became flood prone and consequently, needed to be channeled. Modifications to river hydrology maintain erosion of sediment, lowering of channel bases and consequently catchment-scale lowering of water table. According to the Director of the Aggleteki National Park interviewed in 2007 (see Appendix 3), this ongoing process has manifested its existence in the lowering of groundwater table and discharge in karst channels and springs. This means that at least in parts of the karst systems quantitative status of groundwater is at risk and supplementary actions (in terms of WFD) should be necessary at least in the long run. These should tackle the basic problem involving soil erosion at the river channels and lowering of water table. The local experts have suggested voluntary agreements and purchase of land for restoration of wetlands to stop this process that threats the long term the ecology in the UNESCO world heritage areas of Aggleteki karst.

In general, the problems with groundwater quality occur in local rather that water-body scale. The results of water quality studies in Slovakia are consistent with the Hungarian studies of groundwater quality. The quality standards for nitrates and pesticides are exceeded on in a few sampling points of ENWAT. Also analytical data from previous studies suggest that average concentrations of nitrates remain Quaternary and pre-Quaternary deposits clearly below 50 mg/l. In general, high concentrations are found particularly in fluvial sediments and/or can be linked with potential sources of contamination. Data set both previous and those obtained by ENWAT-project suggest that heavy metal concentrations (Cr, As, Cd, Pb, Hg) that could have adverse ecological or human health impacts if used for drinking are observed in only in few sampling points. The concentrations are in generally low being close to the drinking water standards recommended by World Health Organization and adopted in Slovakia or Hungary. Some of the values may be associated with natural processes (in limestone areas) or result from contamination during sampling and/or due to local contamination by rusty metal casing in wells. There are no indications in the available data sets that these metals would show increasing trends (that should be reversed). In few places, elevated sulphate concentrations have been reported but also these cases appear be limited and result from identifiable potential sources.

Although biological and physico-chemical indicators (including nitrate concentrations) of suggest not good surface water status for significant parts of the river basin (Arcadis 2006; Hungarian Academy of Sciences, see Figure 2) this, based on groundwater pollution data, developed conceptual understanding and regional numerical modelling results, do not suggest that would results from waterbody-scale pollution of associated groundwater. In stead, adverse effects on surface water quality are probably a result of uncontrolled land use and building on flood-prone areas, in sufficient or lack of sanitation and wastewater collection and treatment, in urban residential and agricultural areas in the river valleys. These problems are largely a result of the socio-economic situation in the transboundary areas that represent the poorest and least developed areas in Slovakia and in Hungary. Solution of these problems is probably far from a simple task and involves development of sustainable water supply. Achievement of economically and socially sustainable solutions will probably require governmental or EU-level intervention including specifically targeted programs from structural funds.

Based on the compiled water chemistry data, the chemical status can be considered good. However, karst aquifers are vulnerable to pollution and this should be addresses by developing limit and prevent actions for assuring the good chemical status in the long run.

5.3 Ipoly River valley

According to Hungarian Academy of Sciences, hydromorphological status for the River Ipoly in the area has been considered to be at risk. Also other studies of surface water quality and status have estimated based on ecological stressors (Arcadis, 2006) that surface water quality would not be good in some parts of the river.

The data available in the ENWAT-project included 353 major component analysis, 49 micro component analysis 23 organic component analysis and finally 9 isotope samples taken in the study area. Analyses of main chemical components suggest that nitrates have a substantial impact on the shallow parts (0-20 m) of the groundwater systems. However substantial nitrates pollution (close or exceeding the 50 mg/l quality standard) seems to be limited to less than 50 m deep boreholes (see Figure 4).

More significantly, high pesticide concentrations were found among the samples (Figure 5). In the previous study organized by the Ipel Union (2002) obsolete stocks of pesticides were mapped in the Ipoly River Catchment, altogether in 229 municipalities. As a result 63 obsolete pesticides storages were located in the catchment. In 2003 the mapping continued in the central Trans-Danubian region in Hungary, exposing 42 sites in 410 municipalities.

The samples analyzed in ENWAT-project indicate that high pesticide concentrations are found in both surface water and in groundwater samples. Groundwater samples were taken both in production wells and observation wells. Since the former are characteristically located along the Ipoly Valley and represent a mixture of bank infiltrated surface water and groundwater used as raw water for water supply, the findings of elevated pesticide concentrations call for immediate actions for estimating induced the human health risks and impacts. The latter give background concentrations in the regional (uniform) groundwater flow entering the well-head protection areas.

The surface water samples suggest that pesticides are transported in the Ipoly River itself from the Slovakian side to the Hungarian side (Szőcs, 2008). This is not surprising taking into account the results of Ipoly Union and that in the past use of pesticides in Slovakia appears to have been extremely intensive (Lack and Laffon, 1998). According to this statistic, pesticide consumption in 1997 in Slovakia reached 25 kg/ha. In Hungary, pesticides have been used 1994-1996 about 2.8 kg/ha (World Resource Institute, 2003). For comparisons, in 2002 and 2003 pesticides were consumed in Slovakia about 1.65 and 1.5 kg/ha, respectively (Ministry of Environment, Slovakia, 2006). Based on data from the same sources, the pesticide application per hectare in Hungary in 2002 has been about the same rate as in Slovakia.

Since pesticide samples were taken mainly in Hungarian side of the study areas suggest unfortunately, that the findings can be only a tip of an iceberg. Due to the shape of the Ipoly River Valley pesticide concentrations measured in Hungarian side cannot be simply attributed to the Slovakian sources.

Some of the collected background groundwater samples represent also local recharge areas indicating that pesticides may have infiltrated into the local groundwater flow. Ecology in several protected areas located in the Ipoly River Valley depends on groundwater discharge. Groundwater flow from some of the detected pesticide pollution locations is directed to nature protection areas.

Although number of samples in the Ipoly case is small, they may be an indication of a problem that concerns the whole river basin. The results strongly suggest that urban residential areas and gardens can provide local pesticide sources. Since a large number of small communities are scattered relatively evenly in Ipoly Valley, pesticide pollution can threat the chemical status not only the groundwater bodies but also associated surface water bodies as well.

Since base flow in streams and rives comprises during dry season essentially groundwater, elevated concentrations of pesticides or nitrates in surface waters provide an indication on groundwater pollution in the river basin. They should trigger at least, the review of the measures taken under Article 11 of WFD. Therefore, until additional information is available, it seems to be very difficult to derive any other conclusion but the groundwater bodies associated with the Ipoly River probably have a poor chemical status and if a degreasing trend cannot be indicated in the future with monitoring data, the actions to be taken should cover the whole basin and aim to trend reversal rather than limit & prevent actions in terms of WFD/GWD. Furthermore, the pesticide problem is clearly a transboundary one requiring enhanced co-operation between Slovakian and Hungarian experts and authorities in all levels of environmental administration.

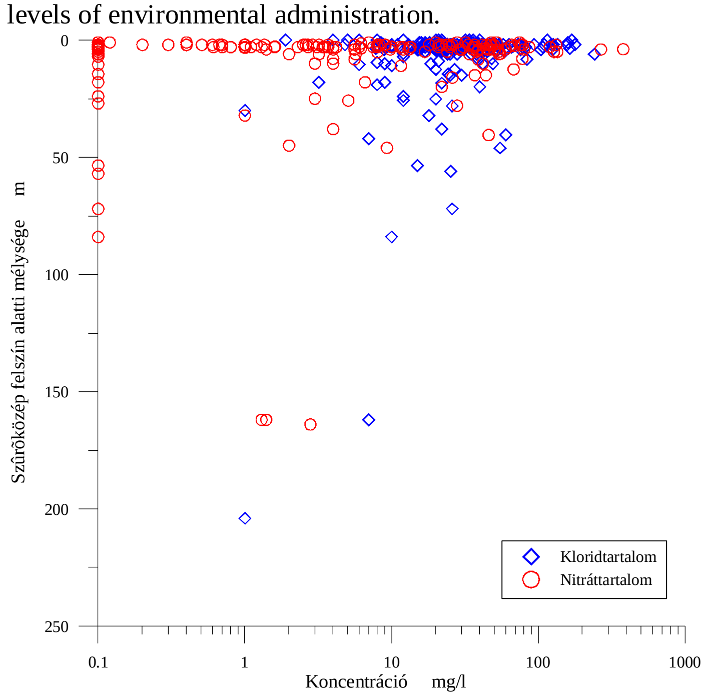

Figure 4. Changes of nitrate and chloride content with depth; Ipoly-valley.

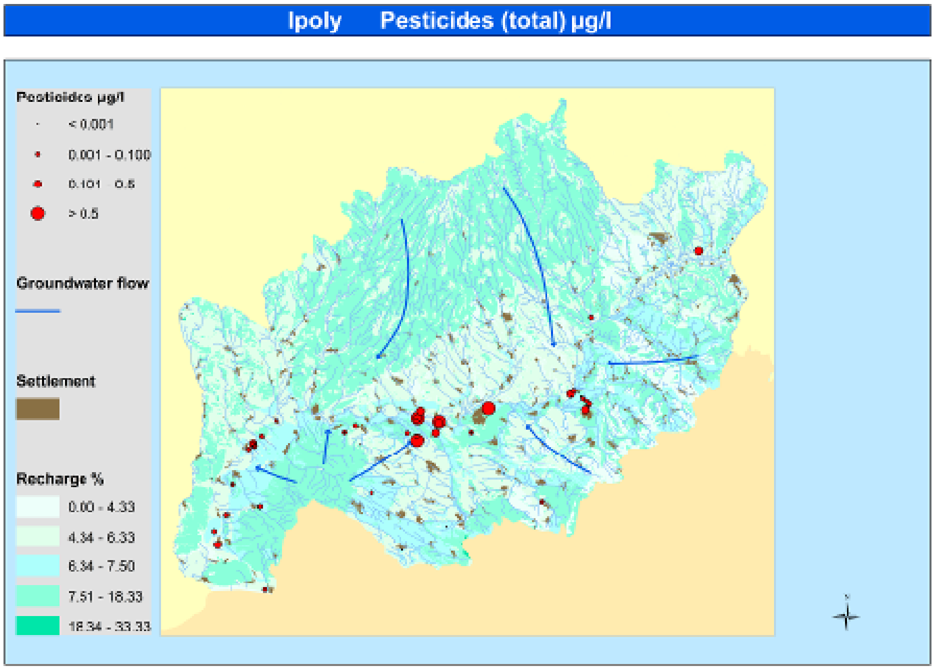

Figure 5. Pesticide sampling points scaled based on the total pesticide concentration, settlements and stream network. Blue lines indicate the regional groundwater flow directions. The background map is color-scaled based on estimated recharge distribution (Smaragd, 2008).

6 Possible trends in the relationship of surface and subsurface water

In previous section, a tentative assessments of the status of groundwater have been made. The assessments are informal, representing expert opinion based on the available information for the Enwat-project and subsequently, provided to Contractor (GTK). The data is limited and therefore, a conservative approach has been selected. These assessements do not necessarily comply with the opinions of the competent authorities, which are responsible for the formal statements as a part of WFD implementation and which can base their conclusions on more comprehensive information.
Furthermore, in the context of WFD particularly the assessment of good chemical status is carried out over the whole of a groundwater body which in general represent relatively large geological formations as is also in the ENWAT study areas. The assessment is carried out once every river basin plan period, and provides a six yearly review of the condition of groundwater bodies. The attainment of the good status of groundwater bodies should be obtained through measures that reverse any sustained and significant trend. The trend analysis concerns therefore, the (whole) groundwater bodies that are at risk of failing the Environmental Objectives. The data sets available are have a limited spatial distribution and do not aprovide representative time series of main pollutant consentrations. The quality assurance, the analythical methods applied in the past may not be comparable to the current ones and in general, the sampling has not been repeated at the same sites etc. Therefore, assessment of trends in the context of WFD has not been possible. The following considerations on possible trends between surface and subsurface water are made based on litterature and hydrogeological judgement.

6.1 Possible trends in the Bodrog area

Based on monitoring that has been continued since 1976, the industrial airborne pollution over 50 % of the localities in the Bodrog region receive higher concentrations of the main analytical components compared to the Slovak average values. The main cations are Ca^{2+}, NH_4^+ and dominant anions are Na+ as and SO_4^{2-} , NO_3^- and Cl- . The spatial variability of chemical contents is significant e.g. TDS (8,17 – 179,2 mg.l-1) and pH (3,72 – 9,34) (Kordik et al. 2007a).

High nitrate concentrations exceeding EU-quality standard is a significant quality problem particularly in Bodrog and Ipoly River Basins. Although oldest nitrate analyses available for the ENWAT-database were obtained in 1930'ies, there is not available systematically monitored data from any observation point. Regional geochemical data available for this assessment collected in different campaigns have not been sampled in sufficiently systematic and repeated manner that would allow estimates on possible developments in average concentrations. Similarly, information on temporal variation is surface waters were not available.

The existence of nitrate pollution in shallow parts of the aquifer systems has been recognized relatively long in Hungary (Vrba, 1988). The previous studies have also distinguished the potential for denitrification in the upperparts (< 20 bgs) of sedimentary cover.

Potentials for denitrification are good based on the information available for this project. The geological setting dominated by fluvial deposits suggest that organic matter, suitable Fe- and Mn-silicates and sulphide minerals that could reduce nitrates are present in solid matrix particularly in deeper parts of the groundwater enabling long term reduction of nitrates. This means that organic carbon for example would donate energy (for bacteria) and donate electron for nitrates. However, based on the available geochemical data in general, redox conditions (low oxygen) temperature, dissolved organic carbon (DOC) concentrations are favorable to indigenous bacterial denitrification processes also in shallow parts of the aquifer system particularly in discharge areas where upward regional groundwater flow provides steady flux of DOC. The regional groundwater flow modelling results suggest that such processes could be possible in extensive areas in the Bodrog-area. In addition, natural denitrification occurs in water logging areas.

In anoxic conditions naturally occurring microbes can biodegrade also organic pollutants in groundwater through processes involving nitrates and sulfates as electron acceptors. Also elevated Fe^{2+} and Mn^{2+} concentrations in groundwater can be indications of such processes.

Due to the good denitrification and biodegradation potential of organic solvents it is possible that most of the anthropogenic pollution can be attenuated so that the good qualitative status and environmental objectives in general can be attained. Final conclusions on these issues need however, additional information and possibly further investigations.

In parts of the Bodrog area, as the part of the regional hydrological and hydrogeological modelling carried out in ENWAT-project evapotranspiration has been estimated to exceed 200 mm/a in areas where infiltration to groundwater remains 0-25 mm/a which substantially increases concentrations of dissolved components in soil moisture and grounwater. The precipitation has been estimated to range 540-660 mm/a.

In the groundwater discharge areas in general, in which groundwater table is close to surface, the climate change can bring impacts on terrestrial ecosystems dependent on groundwater. The impacts can be particularly significant, if TDS concentrations (and electric conductivites) are high in discharged shallow groundwater and groundwater table reaches root zone. Consequently, a shallow water table continues provide moisture to the root zone enhancing evapotranspirative pumping to the atmosphere. In semiarid regions with precipitation 250-500 mm/year, TDS contents ranging 500-1000 mg/l in irrigation water has been found to have detrimental effects on sensitive crops while TDS concentrations exceeding 1000 mg/l have adverse effects on many crops (Water Quality Committee, 1972). The observed TDS values already exceed these values in many places in the Bodrog area and the climate can change to somewhat semiarid-like conditions at least during the drought seasons may occur in future.

To analyze possible regional climate changes over Europe 10 regional climate models (RCM) have been developed. When these model outputs have been compared to with historical data shows that the spread in model predicted changes in extreme temperatures is larger than the natural variability during the last centuries (Kjellström et al., 2007). Comparison of climate change model outputs has also lead to suggest that future climate in central Europe will also likely show stronger dependence on land-atmospheric coupling (Seneviratne et al., 2006). The contribution groundwater discharge to evapotranspiration probably requires specific modeling as suggested by e.g. by Person et al. (2003). Therefore any attempts to project changes in the interactions between soil moisture, temperature, wind intensity and solar radiation (that control evapotranspiration) to quantitative assessments on the local effects on shallow groundwater or soil moisture concentrations or on ecological impacts were not attempted in this study. However, it is considered that increasing evaporation due to warming climate or changes in river dynamics can also increase critically concentrations of dissolved components in shallow groundwater. Due to the already high concentrations of Cl- and TDS and electric conductivity, careful monitoring and water management in the changing climatic conditions will be required in the Bodrog-region.

6.2 Possible trends in the Aggleteki-Slovakian karst area

The channel erosion in hydraulically modified river channel probably continues to lower the river and stream stages in the Aggleteki-Slovakian karst region and subsequently lower the regional groundwater table.

The water levels in karst channels are particularly vulnerable to the changes in regional water table.

Unfortunately, the climate change that most certainly increases extreme hydrological events will likely impact on river run in Aggleteki-Slovakian karst area. In a worst scenario, higher and more rapid flood peaks will set pressures to continue the previous flood “control” while drought periods damage the ecology of the karst areas. This would hit badly the ecoturism which provides an important component of the economy in the region.

Uncontrolled land use and lack of wastewater treatment or waste management will probably maintain or even increase water quality problems in this area. The long-term solutions can be to the situation comprise integration of wetland rehabilitation and restoration of the functioning as flood storages. The rehabilitation and even creation of constructed wetlands could provide solutions to local wastewater treatment and new possibilities to develop ecoturism in the area. Finding sustainable water management solutions should be supported by socio-economic development of these low-income areas.

6.3 Possible trends in the Ipoly River valley

The most crucial issue for the groundwater management in the Ipoly River Basin are the possible trends with the pesticide problem. Pesticides, particlarly the formely allowed and extensively used antrasine and its metabolites are persistent in the environment and mobile in the hydrological cycle. This means that sorption and biodegradation do not provide natural attenuation reducing their environmental concentrations.

As a part of groundwater vulnerability assessments and flow modelling in ENWAT-project conservative tracer transport (advection and dispersion) in soils typical to the modelling areas was modelled in 1D. These indicated that in depending on the thickness and soil properties of unsaturated zone, migration of pesticides through unsaturate zone from surface to groundwater can take up to tens of years. They can manifest their existense in groundwater years or decades as after they have been released into the environment and even years or tens of years after they use became forbidden. Also concentrations of they may remain in unstaturated soils and released e.g surface water by soil erosion during flooding. Therefore, a significant risk exists that the current pollution situation in the Ipoly River Basing continues or even gets worse in the near future. In the past, currently forbidden pesticides have been used widely in particularly Slovakia but also in Hungary. A great number of obsolete pesticide stock have been found in the region (Ipoly Union, 2002, 2003). At these sites soil is probably strongly polluted providing long-term pollution sources for groundwater pollution.

In future the climate change may increase e.g. the flooding levels and risks in general. These may lead to erosion and rinsing of pesticide polluted soils into surface water in the area.

During the stake holder meetings arranged as a part of this study, they expressed they concerns on the environmental impacts of e.g. the more intensive pig farming that is today practised in the Ipoly River Basin. Such changes probably can worsen the nitrate pollution of groundwater and eutrophication of associated surface waters in the area.

7 Current water usage, the future possibilities and limitations of water production

The service, technical and operational issues of the water supply systems can be examined from many different viewpoints. The most essential points for the customer are the quality of water, reliability of everyday water supply and the price of water. From the municipality point of view the central issues are water quality, reliability of water supply systems, extension of the water system network, preparedness for risks and for state of emergencies and water price. All abovementioned points are essential for the existence of water works and thus the primary aims of water works are related to them. Regional point of view combines all these objectives and furthermore aims to the regional water management and water resources optimization. Finally, the transboundary view emphasizes the river basin approach.

7.1 Requirements of the Water Framework Directive for water quantity

Water framework directive addresses the importance of water quantity and obliges that within the river basin district the impacts of the freshwater abstraction to the groundwater bodies must be defined. Overall principles should be laid down for control on abstraction and impoundment in order to ensure the environmental sustainability of the water systems.

Water Framework Directive requires that a balance between groundwater use and recharge must be ensured because ecological and chemical status of water bodies strongly depends on the flow of water. This means e.g. that water use patterns together with water abstraction points must be established except in areas where it can be verified that abstraction will not have considerable impacts on the quantitative status of water. Moreover, WFD requires a register of water abstractions and authorisation procedure for their construction and operation. Both Hungary and Slovakia already have such registration and licensing system to maintain the groundwater bodies and protect the water resources.

Abovementioned requirements with the full cost-recovery pricing policy will contribute to the protecting of water bodies as a resource.

If transboundary groundwater bodies have been identified in Initial Characterisation (Annex II of WFD) as being risk of failing to meet the objectives set for each groundwater body, the following data must be gathered and registered:

1. location of points in the groundwater body used for the abstraction of water,
2. annual average rates of abstraction from such points,
3. chemical composition of water abstracted from the groundwater body,
4. location of points in the groundwater body into which water is directly discharged,
5. rates of discharge at such points,
6. chemical composition of discharges to the groundwater body,
7. land use in the catchment or catchments.

The most significant and major target group represents the population living in these transboundary regions, using groundwater bodies as a major drinking and household water supply, but also as a source for irrigation, industrial and recreational purposes.

In the frame of the ENWAT-project most of the above mentioned information have been gathered, documented and registered in the ENWAT GIS-system maintained by MÁFI. Relevant water abstraction data from the areas of Aggteleki-Slovakian karst, Ipoly river valley and Bodrog area have been compiled by MÀFI and SGUDS from databases of Hungarian and Slovakian national water authorities. In the following a summary of these regional data and water use in general in Hungary and Slovakia is presented together with the future possibilities and limitations of water production.

7.2 General water use trends in Hungary and Slovakia

Water production data are compiled by the relevant Water Authorities of Hungary i.e. Kövizig´s (Észak-dunántúli Környezetvédelmi, Természetvédelmi és Vízügyi Felügyelőség, Győr; Közép-Duna-völgyi Környezetvédelmi, Természetvédelmi és Vízügyi Felügyelőség, Budapest; Észak-magyarországi Környezetvédelmi, Természetvédelmi és Vízügyi Felügyelőség, Miskolc) and Water Research Institute of Slovakia (Výskumný ústav vodného hospodárstva, Bratislava). These data are also available from the three groundwater body groups of ENWAT research area. However, datasets are not always complete, for example Hungarian dataset are incomplete up to the middle of 1990´s and do not contain the real values most of the times (Tóth, 2007).

Based on the Hungarian data interpretation the maximal water production was from the late 1970´s to the late 1980´s, after that water use decreased drastically until the beginning of 1990´s. In 1992 the water abstraction (surface water and groundwater) reached its peak, almost 7000 million m^3 of water was abstracted in Hungary and about 750 million m^3 in Slovakia. From 1992 to 2006 there has been considerable reduction in water production in both countries (see Figures 6-10 below).

7.2.1 Hungary

In Hungary the annual total use of water (surface water and groundwater) in 2006 was about 5,2 km^3 of which the drinking water supply counted about 10%, agricultural water including irrigation about 13%, industry and hydropower for 77% (Figure 6). Public water supply is based to about 95 % on groundwater, which is clearly more than in most European countries. In addition, the groundwater resources are derived from different types of aquifers e.g. in karstic (20%), bank filtered (30%), deep (40%) and shallow (10%) porous aquifers which can interact with surface waters (Ministry of Environment and Water, 2002). The average specific household water consumption was 151 l/person/day in 2005 (European Water Association, 2005).

As can be in Figures 6 and 7, there is an obvious declining trend in the water consumption in Hungary from 1992 to 2006; for example consumption of drinking water and agricultural water diminished for over 27% and 36%, respectively. At the same time the total water abstraction declined 23% from 6,9 km^3 to 5,2 km^3. This has been general trend in most of the settlements during the last decade. This is partly due to the increase in water prices (see Figure 8) and the result of transformation of economy, increase in water reduction in production, as well as introduction of new technologies. The higher costs for drinking water leads to the construction of own illegal water supply wells in the upper surficial groundwater bodies, where the risk of water contamination is bigger.

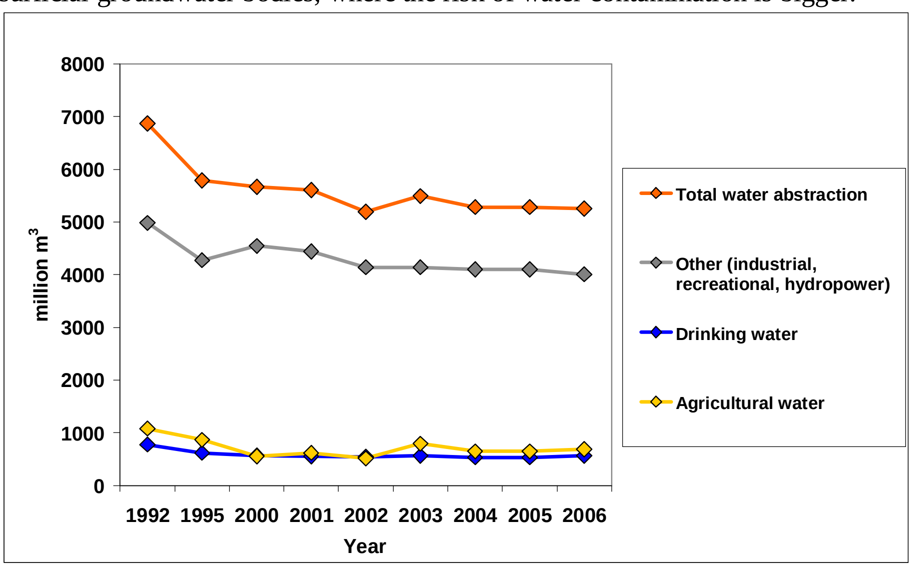

Figure 6. Annual water abstraction (surface water and groundwater) trends of different categories in Hungary 1992 – 2006 (Hungarian Central Statistical Office *http://portal.ksh.hu/portal/page?_pageid=38,597317&_dad=portal&_schema=PORTAL)*

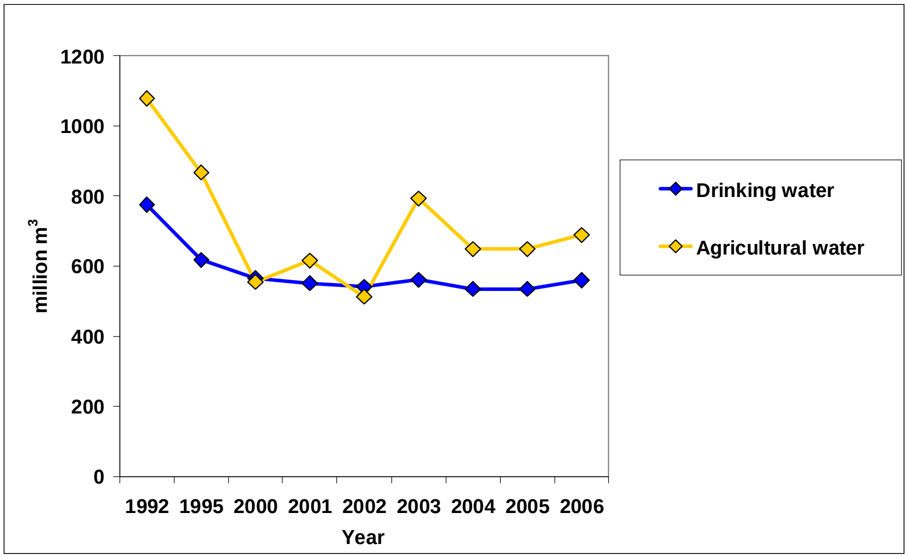

Figure 7. Annual drinking water and agricultural water abstraction trends in Hungary 1992 – 2006 (Hungarian Central Statistical Office [*http://portal.ksh.hu/portal/page?_pageid=38,597317&_dad=portal&_schema=PORTAL*](http://portal.ksh.hu/portal/page?_pageid=38,597317&_dad=portal&_schema=PORTAL) *).*

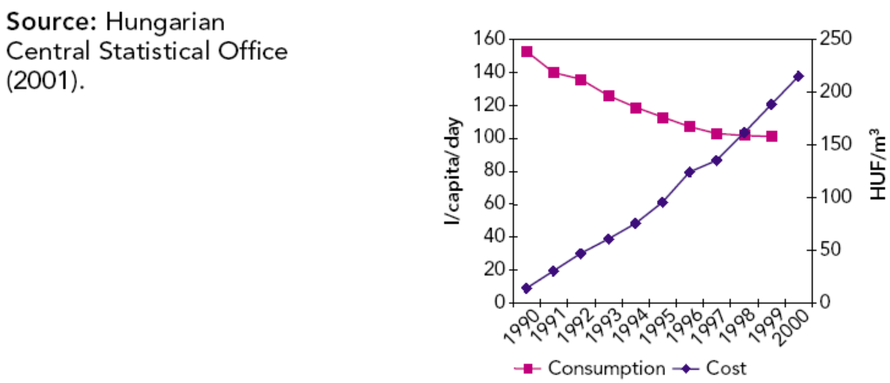

Figure 8. Comparison of household water price and water consumption in Hungary 1990 – 2000 (European Environment Agency, 2003).

7.2.2 Slovakia

In Slovakia the annual total production of groundwater in 2003 was 314,1 million m^3 of which the drinking water supply counted about 75 %, agricultural water including irrigation about 6,2 % and industry for 10 % (Figure 9). 85,3 % of the inhabitants are supplied with the drinking water from public water supply.

Public water supply in Slovakia is based to about 85 % on groundwater, 15% comes from surface water. The specific household water consumption has a declining trend; in 2003 it was 109 l/person/day, in 2004 99,7 l/person/day and in 2005 only 91,9 liters per person per day. This is partly due to the pricing policy where high costs for drinking water can lead to the uncontrolled construction of own water supply wells in upper surficial groundwater bodies where the groundwater can be of poor quality (Ministry of Environment, 2005).

Reduced groundwater abstraction can be seen in figure 4 and according to the Ministry of Environment it is seen for the most of the abstraction categories. Other sectors besides water supply, e.g. industrial, have shown a slight reduction in used water volumes by 2 – 6 % compared to previous periods.

Reduction in water use after the year 1990 is the result of transformation of economy, increase in water prices, reduction in production, as well as introduction of new technologies. In Hungary more or less same situation prevails (compare Figure 8).
http://enviroportal.sk/pdf/spravy_zp/br05-en/12_Groundwater.pdf

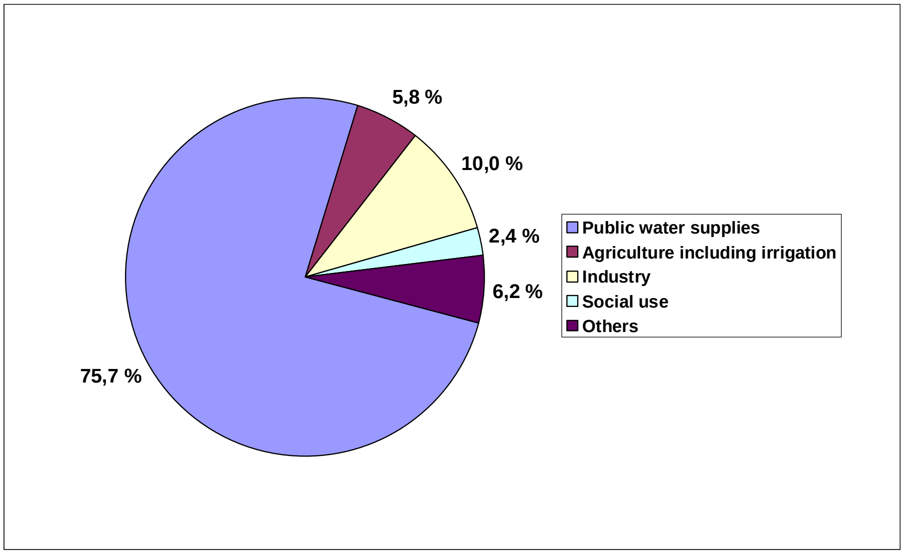

Figure 9. Groundwater abstraction in 2003 in Slovakia according to the purpose of use (modified from SHMU data). The total amount of groundwater produced in 2003 was 314.1 million m^3 (SHMU, Ministry of Environment of the Slovak Republic).

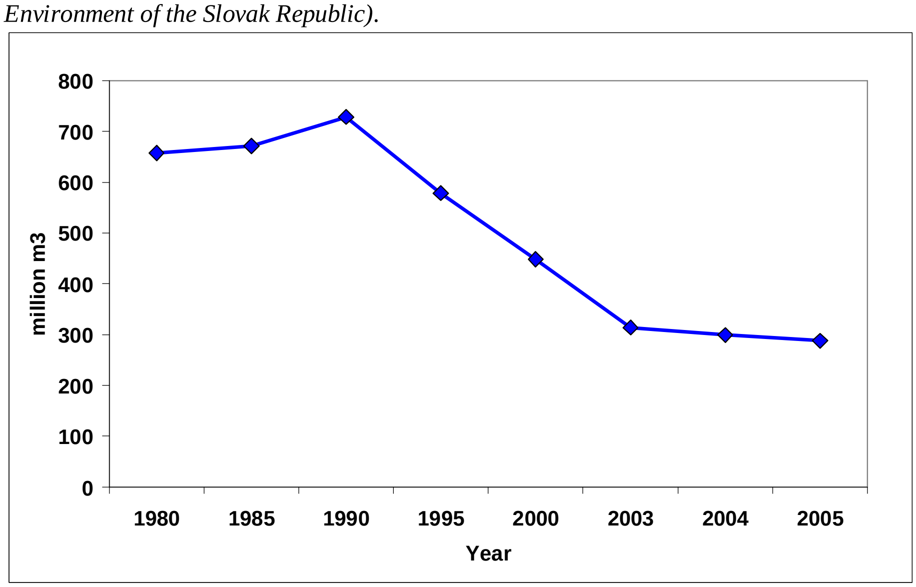

Figure 10. Groundwater abstraction in Slovakia 1980 – 2005. (modified data from Ministry of Environment of the Slovak Republic, 2005; and http://enviroportal.sk/pdf/spravy_zp/br05-en/12_Groundwater.pdf

7.3 Current water use in Bodrog, Aggteleki-Slovakian karst and Ipoly areas

Based on the information gathered from the national databases and the data provided by MÁFI and SGUDS, the total groundwater abstraction rates in 2002 in the research area are as follows:

- Bodrog: 61 442 m^3/day
- Aggteleki-Slovakian karst: 33 747 m^3/day
- Ipoly-Ipel: 101 106 m^3/day

In the following table some key figures of the water abstraction from the research areas have been presented. It should be mentioned that the data is not coherent, for example water abstraction divided with the different use categories is available from Slovakia but not from Hungary.

Population data were downloaded from the Hungarian Central Statistical Office (http://portal.ksh.hu/portal/page?_pageid=38,597317&_dad=portal&_schema=PORTAL) and from the Statistical Office of the Slovak Republic (http://px-web.statistics.sk/PXWebSlovak/index_en.htm).

Table 1. Key figures of the groundwater abstraction from Bodrog, Aggteleki and Ipoly.

Area	Number of settlements	Number of water production wells	Population	Groundwater abstraction m^3/day	Public water supply m^3/day	Industry m^3/day	Agriculture m^3/day
Bodrog (HU)	155	793	824 359	45 641	-	-	-
Bodrog (SK)	46	89	237 665[1)]	25 801	11 771	1 1591	336
Aggteleki (HU)	60	134	133 693	6 240	-	-	-
Slovakian karst (SK)	67	100	449 009[2)]	27507	23 062	358	1 060
Ipoly (HU)	60	326	278 506	77 289	-	-	-
Ipel (SK)	150	281	400 528[3)]	23 817	19 006	475	1146

1) Total population in the districts of Trebišov, Michalovce and Sobrance
2) Total population in the districts of Revúca, Košice I-IV, Košice – okolie and Rožòava
3) Total population in the districts of Levice, Velky Krtíš, Zvolen, Banská Štiavnica, Detva, Krupina, Lučenec and Poltár

Figures 11-13 shows the proportion of different groundwater abstraction categories in 2002 in Slovakian areas. The water abstraction pattern is more or less the same in areas of Slovakian karst and Ipel. In the case of Bodrog, the proportion of industry and public water supply is almost the same due to the extensive water needs of the U.S. Steel Kosice industrial area (about 10500 m^3/day).

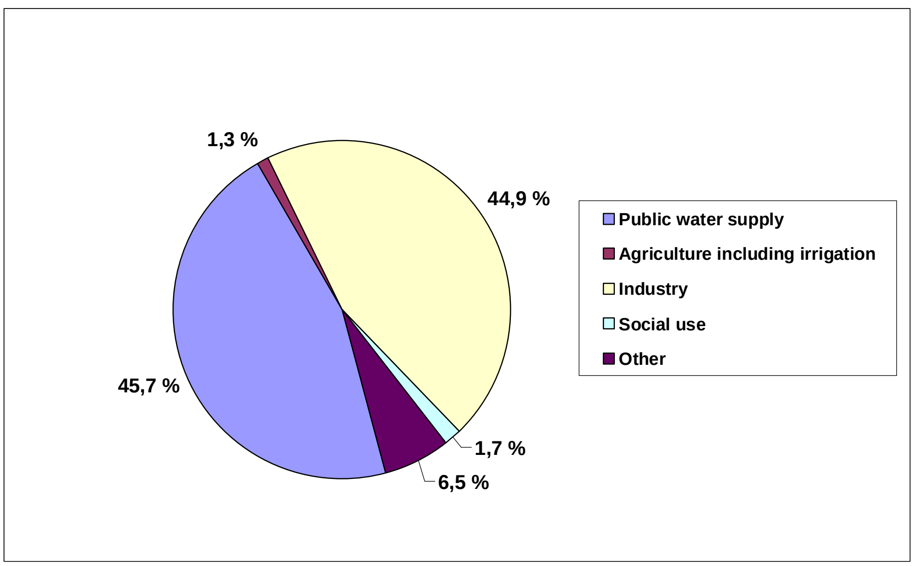

Figure 11. Groundwater abstraction in Bodrog area according to the purpose of use.

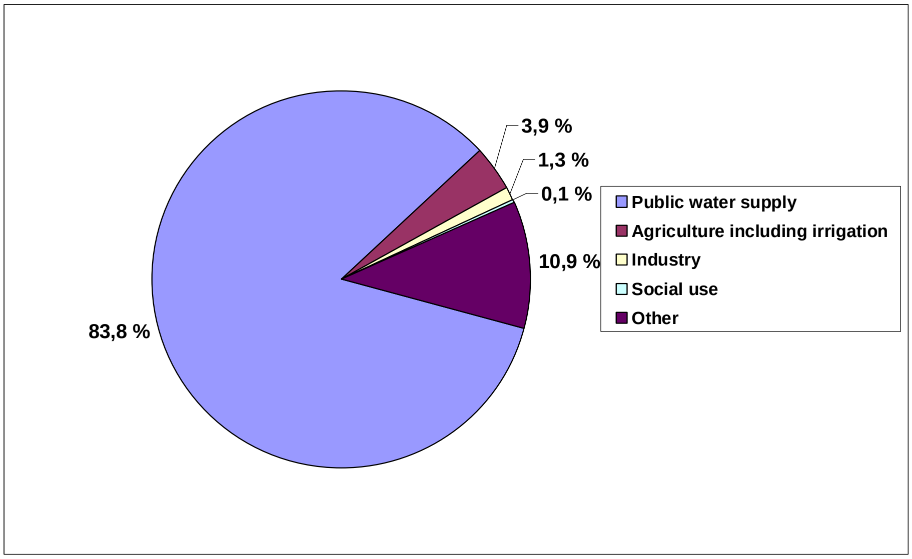

Figure 12. Groundwater abstraction in Slovakian karst area according to the purpose of use.

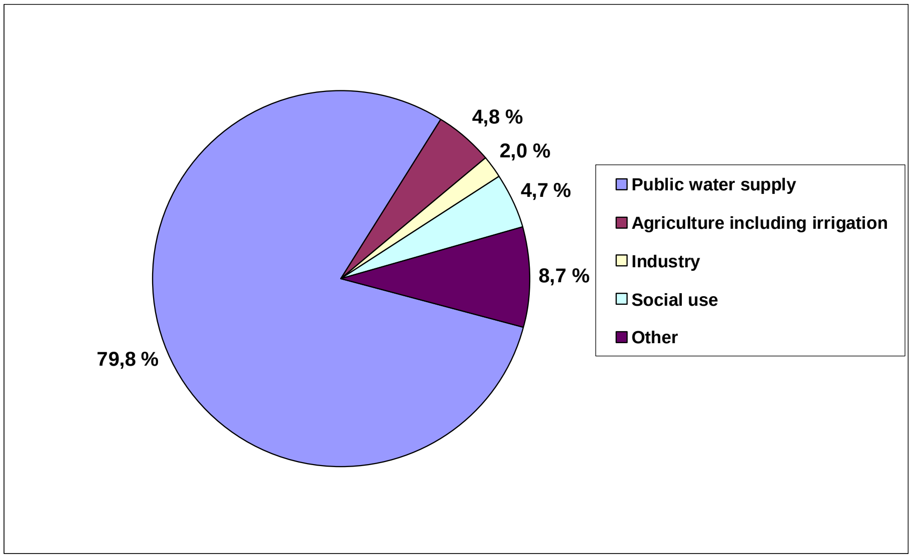

Figure 13. Groundwater abstraction in Ipel area according to the purpose of use.

7.4 Future possibilities and limitations of water production

Detailed estimations of the future water abstraction in the three areas have not been made although it would be crucial for the strategic decisions in respect of regional drinking water supplies and especially for the settlements. Broad estimations have been made for example by the Slovakian water Research Institute (*"General Plan of Protection and Rational Use of Water - Issue II"*) (see Table 2).

Table 2. Review of basic parameters of development in need of drinking water (Ivanyova, L., 2002).

INDICATOR	**Unit**	**Year 2000**		**Year 2010**
		*	**	
Number of inhabiting population	thousand	5,401	5,401	5,484
Number of supplied population	thousand	4,479	4,479	5,131
Share of supplied population	%	82.9	82.9	93.5
Need of water Q_{pr}	$l.s^{-1}$	13,490.6	13,689.6	17,130.6
Supply to households	$l.s^{-1}$	6,262.5	6,432.4	8,240.7
Specific need by households	$l.inh^{-1}.d^{-1}$	120.8	124.1	138.8

Share of non-invoiced water	%	30.1	28.1	24.0

Notes:
** actual status, including the villages below the hygienic minimum.*
*** actual status – the villages below the hygienic minimum adjusted to hygienic minimum*

The current trend in water consumption for both countries is declining. According to Ministry of Environment of Slovak Republic, water supply for households is decreasing despite the fact that the number of supplied inhabitants increased. In 2005, for example, the specific consumption of drinking water decreased to 95 l/person/day. This was due to the high price of water and changes in economy which lead to the construction of private drinking water wells of poor hygienic and chemical quality. (Ministry of Environment, 2006).

During the ENWAT fact finding missions the project group visited the Stredoslovenská vodárenská prevádzková spoločnosť, a. s. – Central Slovakian Waterworks (see Appendix 4). This operational enterprise is possessed by the French company Dalkia, and distributes the water on the area of about 10 000 km^2 of the south of Central Slovakia. Central water pipeline system on this territory is based on gravitational groundwater of karstic springs (north), and on accumulated surface water in the 3 reservoirs (on the south). As the water prices are increasing, although regulated by state (in 2007, ~1.55 €/m^3), water consumption decreases and more drinking water remains available in the supply system.

Calculated capacity of water supply requirements of Central Slovakian Waterworks is about 0.120 m^3/day/person, and a project of prolonging pipeline system to the small municipalities on the south is elaborated, waiting for EU funding support. The problem is, that this border region is economically week, mostly inhabited by elderly people who are not able to economically secure the final distribution to individual houses.

Generally, the population increase in the rural agricultural areas in both countries is low and the age structure reveals the ageing of the population. Also a problem of finding alternative groundwater sources for individual municipalities is a problem of water price. Waterworks themselves have enough capacity from existing sources, and are leaving protection of prospective sites as they should pay the owner of property (land) not to agriculturally use the drinking water sources protection zones.

Central Slovakian Waterworks has had negotiations with the decision makers of Salgótarján region about the water supply. Presently, Málinec dam is ready to supply the Salgótarján region in Hungary.

ENWAT partners also visited and interviewed the mayor of Pastovce (560 inhabitants) Mr. Oto Mészáros (Appendix 4). Pastovce municipality have their own water supply system, relying on a Neogene deposits aquifer exploited by a 100 m deep borehole, drilled in the 1970ies and rejuvenated in 1990ies. The drinking water supply system is relatively cheap in comparison to centralised water distribution by major waterworks (~0.36 €/m3), but to maintain it due to high hygienic standards requires a lot of effort – mayor himself would like to give up the maintenance of the drinking water supply system and to transfer these duties to the West Slovakian Waterworks, although the water price then should rise up several times.

Pastovce has also a water treatment plant, suitable for other neighboring municipalities, but the neighbors hesitate to join, because they are probably afraid of the fees that might be required by the owner. According to the Mr Mészáros, the neighboring municipalities are not able to formulate the common interests, which make the problem of drinking water distribution also uneasy.

According to the ENWAT groundwater model exercises done by the SMARAGD-GSH (2008) the following conclusions can be drawn. Modelling of Ipoly valley catchment area showed that there is a sensitive hydraulic state of equilibrium between the alluvium of Ipoly, the older porous medium filling the basin, and the mountains in the surroundings and that then status of the water production is sustainable.

Aggteleki-Slovak karst groundwater model showed that the karst water system is in a sensitive state of equilibrium; and that the balance of the water budget of the area can be held by the water abstraction which is realized mainly by the yields of springs. Furthermore, a significant water production from wells will result in less yields of the springs mainly during the arid periods. The springs implemented for water production would dry out and thus causes water deficit.

Bodrog basin groundwater model proved that the water budget of the drainage basin in natural conditions is in a state of equilibrium, which is determined by the infiltration originated from the precipitation, the evapotranspiration, the drainage in the mountainous area and the hydraulic behavior of the riverbeds. There is "overproduction" of groundwater in the Bodrog drainage basin but the unfavorable hydrogeological processes and the unrequested manifestations of the closely connected water budget (shrinking or disappearing of wetland habitat) can be touched upon the territories which are in central position of the basin and still have good water state of supply.

8 Proposed water management measures to be taken

In the following list of actions proposed to be taken are given in a priority order that is based on the hydrogeological evaluations and regional models in order to optimally sustain water management. Since actions considered necessary to protect human health are given the priority, securing safe drinking water supply is preceed action aiming to minimise impacts to the environment.

The proposed water management measures are given in the reference to the requirements EU WFD and GWD. This level of referencing is considered to be necessary assuming that these requirements are already fully adopted in the national legislation in Hungary and Slovakia.

The measures are considered to be implemented as a part of the Programme of Measures required by Article 11, of WFD and to be reported accordingly in the River Basin Management Plans. This means that they are classified in principle as Basic and Supplementary Measures, or Additional Measures if monitoring or other data should indicate that the Environmental Objectives for the water body are unlikely to be achieved.

The specifications for programme of measures river basin management plans required under WFD, as well as the clarifications brought by GWD to the implementation of WFD are discussed more specifically in Appendix 1.

8.1 Development of water services in rural areas

In the participating countries, the solutions for drinking water supply of urban settlements have been contrastingly different. In Hungary, about 90 % of the urban water supply is based on groundwater from relatively deep aquifers or artificially infiltrated water. The latter being characteristically a mixture of groundwater and bank-infiltrated surface water. The water is therefore characteristically distributed by a local water works companies. In Slovakia, drinking water urban settlement is essentially surface waters from lakes or reservoirs that are located mainly in the central mountainous areas of the country. In order to distributed to the consumers through long pipelines. Plans exist to extend the Slovakian pipeline system to distribute water to Hungary at least at the Ipoly River Basin. Differences between countries exist in the involvement of private enterprises and particularly in limitations concerning the private ownership of water works or wastewater treatment plants.

In both countries, the measures aiming to assure cost recovery for water services by 2010 are currently in progress (WFD, Article 9). Reorganization of the water sector as a part of the economic transfer in both of the countries has been a challenge and also politically controversial task. In this process, the previously state owned public utilities have been transferred to the municipalities during the political changes at the beginning of the 1990's. However, property managing and maintenance of regional and large urban water services and the necessary assets is carried out by a few companies. In Hungary, these comprise five state-owned undertaking that work under the supervision of the Ministry of Environment and Water. In Slovakia, the operators in the water sector include international private company Veolia. The regional public utilities and the assets which the municipalities were not willing to take over were left to the state ownership. To carry out the transfer, both countries have received supervision and financial support from international organizations such as World Bank, EU, OECD, UNDP etc. The general focus of the development and reform of water sector has been on the large regional services.

Municipalities have different means to manage the property handed over for them during the transfer. In many places this property is managed mainly by the legal successors of the previous incumbent firms while smaller villages set up jointly controlled undertakings to assume this responsibility. In some cases the water works are maintained directly by subdivision of the municipal administration. There are also a great number of households that have their drinking water from private wells.

In the ENWAT-study areas, examples of the rural settlements exist that have recently built or modernised local municipal water works that intake good quality groundwater from relatively well protected aquifers. Some of them, e.g. the water works of the Pastovce municipality in Slovakia, can currently provide water to their customers with a relatively competitive price compared to current tariffs of large water works or a foreseen water price given by a local large water company. The prices of small municipal water works do not necessarily reflect all the costs, needed e.g. to cover future investments. Municipalities have also had problems to maintain sewage systems or built modern sewage and waste management systems in general. Many of the nitrate problems encountered in the study areas are a result of solid waste dumps and leaking sewage systems in the rural settlements.

During the stakeholder meetings organized as a part of the ENWAT became evident, that the studied river basins include substantial areas which are out of the interest of the regional water works companies either because, alternative water sources are available, or customer potential (ability and/or willingness to pay) of the population remains too low. The business plans of private water companies do not always aim to target services to all income sectors of the population.

The supply of healthy drinking water and the treatment of sewage is remains an obligation of municipalities. Maintenance of the local water supply capacity is important part for the preparation of crisis situations that may be encountered if the functioning of regional water distribution systems for some reason. The specific problems that small municipal water services face is that the every-day operation rests on local staff who do not necessarily have appropriate skills or formal training, or other resources to carry out technical maintenance e.g. of the pumps and electric power supply, or to carry out water quality monitoring. Solutions and economical efficiency should be sought supporting municipalities in arranging e.g. Private-Public-Partnership (PPP) or service contracts giving undertakings to local small civil engineering and hydrogeological consulting companies or training staff members already at the payroll of municipalities to support or carry out as part time the tasks of water sampling and monitoring according to modern quality standards. The work load of municipal administration and water works management could be simply eased-up by preparing a public collection of model contracts that small municipalities or water work companies could use. The model contracts would naturally take into account the national legislation in setting fair and legally valid standards for procurement procedures and for service or PPP-contracts. A cost-efficient model for small municipalities can be obtained from Finland were veterinarians (employed by municipalities or private service providers) commonly consult and carry out water sampling in small rural settlements and communities. They can act also as municipal authorities in the environmental, health and sanitation issues or support such administrative personnel. Their academic training includes also courses supporting these activities. An alternative target group could be example school teachers.

Drinking water quality problems are common in all three areas in small rural settlements, farms and single households that derive their drinking water from dug wells or boreholes. Most of the boreholes are shallow or have casing opening into the shallow aquifer layers (< 20 m deep), which are extensively polluted by nitrates and other anthropogenic pollutants. Although, quantitative statistical information on the public health impacts of e.g. nitrates and bacterial pollution was not available, the local population, which in many settlements has low-income and poor standard of living, commonly suffers from poor quality of drinking water as addressed by the local stakeholders and experts interviewed.

The quality problems are commonly a result of poor site selection and technical design of the well as well as a lack of aftermath insufficient or obsolete sewage systems. The former could be avoided by supporting the establishment of small water-co-operatives (or municipal joint-ventures) that would be also recover at least socially accepted part of the costs of investment and maintenance. Single household should be required to install sewerages which could include so called semi-separated sewage systems utilizing biodegradation in infiltration sand beds. Also more efficient use of constructed wetlands in small-scale sewage treatment should be supported. Design of e.g. the voluntary programs and setting pricing policies for waste management and waste water management for small settlement and single households should be supported from public funding (national, e.g. EU structural funds). Households locating in sensitive areas should be requested to pay a socially acceptable fee for the waste production but admitted exemptions from paying if modern sewage systems have been installed.

Social and economic sustainability should be considered jointly with developing local policies and measures necessary to ensure the environmental sustainability in these areas. This means that regional and municipal level planning of water services should be incorporated with regional spatial and environmental planning and other relevant plans. Good experiences have been obtained in Finland where characteristically small municipalities are encouraged to co-operate in master planning of water services in local and regional level though financial and operational incentives built in the legislation as well as guidelines and administrative codes laid out by Ministry of Environment. A short introduction to the Finnish Environmental Planning System is given in the Appendix 2 of this document.

The measures to be taken support actions planned and integrated in a suitable manner to the national and EU-level programs that aim to improve the living conditions and social inclusion of the Roma-minorities both in Slovakia and Hungary. This is necessary particularly if future building of huts and settlements on unauthorized or unregulated areas such as flood prone areas is going to be avoided or prevented in ethically acceptable way.

The programs and regional projects should take into account the decreasing population of the areas and the fact that many of the settlements are unauthorized and locate in flood-prone areas or areas were lack of proper sewerages and waste management can pollute groundwater and associates surface water bodies. The programs and projects should be supported by detailed land use plans that clearly indicate were house-building is directed in future.

The programs and regional projects could easily fail if the new obligations and water service pricing is not supported with sufficient regulative empowerment and most importantly, incentives to comply and benefit from the improved service. Also awareness rising on the benefits of improved drinking water quality and health risks of polluted water among the local population should be addressed, including the poor and the socially excluded. Otherwise, the programs and projects could even have an opposite effect worsening the current situation. People would try to avoid paying for water services by building they own wells to the pollution-prone shallow aquifers system, and continue to contribute to the pollution of the shallow parts of the aquifers and associated surface water bodies.

In a social-economic conditions prevailing in the Hungarian-Slovakian border areas, with poor standards of living among the roman-population particularly and un-permitted settlement locating in flood prone areas etc., the achievement of water-pays-water and polluted-pays policies in the house-hold level is hardly possible within the first RBMP-period (and should be explained in the RBMP).

8.1.1 Concrete measures

The following measures are proposed to be taken in all investigated areas.

1. Continue the development of water services by regional operators and large entities according to existing programs.
2. Support modernisation and updating of municipal water works, wastewater treatment and solid waste management in areas left without regional water services in general and integrating their services and water planning to other local and regional level plans to meet the needs for integrated water resources management. Plans should consider also local boreholes and well fields as alternative water sources during crisis situations and water shortages.
3. Training of local experts for different aspects of water services, particularly on operation and maintenance of small and medium size water supply facilities, and sampling and monitoring of water quantity and quality (QA/QC, monitoring microbes, organic pollutants, heavy metals etc.) according to the requirements set e.g. by new EU-legislation and/or training on procuration of such services by available service providers.
4. To support municipal administration or for managers of small municipally owned water work outlining model contracts, guidelines for procuring services or setting Private-Public-Partnership arrangements in compliance with national legislation and policies.
5. Support establishment of water co-operatives for improving water supply of small settlements, or groups of households, farms and small companies in conjunction with the regional and local social and economical development measures, supporting improvement of the living

conditions of the poor and socially excluded part of the population, particularly Roma-minority both in Slovakia and Hungary.

6. Supporting installation of small and cost efficient wastewater and sewage treatment systems (semi semi-separated sewerages with biodegradation in infiltration sand beds and constructed wetlands) small settlements, or groups of households, farms and small companies in conjunction with the regional and local social and economical development measures, supporting improvement of the living conditions of the poor and socially excluded part of the population, particularly Roma-minority both in Slovakia and Hungary.
7. Development programs supporting the needed social integration should be initiated. Social and economic sustainability should be considered jointly with developing local policies and measures necessary to ensure the environmental sustainability in these areas. These projects should also develop incentives to improve rural water services (covering including drinking water and wastewater) and consider the social, environmental and economic effects of the cost recovery as well as the geographic and climatic conditions of the region or regions affected.
8. Assure by the further co-operation of decision makers and stakeholders in cross-border, regional and municipal level, that the afore mentioned actions will be in compliance and integrated with the ongoing RBMP-process as laid out in WFD.

8.2 Assessment, limitation and remediation of the pesticide pollution

In general, the pesticide concentrations detected in ENWAT-project suggest that water quality must be considered to be at risk until further investigations have been made and the additional measures as defined in Article 11, WFD have been taken. Additional information on the pesticide concentrations in groundwater, unsaturated zone and surface water are needed to be collected urgently. Besides better mapping of the pollution situation and a review and adjustment of environmental monitoring, these investigations should also aim to clarify the causes of possible failure, include review and examination of relevant permits and authorizations.

Somewhat alarmingly, authorities in both countries have apparently not been well informed about the previous findings concerning the existence of obsolete pesticide stocks in the region. It will be important to improve co-operation and information sharing among different levels and between different branches of environmental administration in this region. They should however, also assure that the obsolete stocks have been now remediated. Based on the previous studies of Ipoly Union (2003), suitable incineration facilities that would fill EU-standards were found only in Hungary. This also calls for open and transparent cross-border co-operation between the regions and regional authorities.

Analyses of drinking water samples should be carried out to exclude the human exposure in drinking water intakes that locate down-gradient from potential risk areas (urban residential areas and gardens). If necessary, the use of polluted drinking waters should be limited.

Although use of atrazine is forbidden today, the investigations should reveal if atrazine is still used from “old stocks” or if it is included into products that have been imported outside EU. Since current estimates on the ecological and human health impacts on allowed pesticide and herbicides are based on somewhat limited or controversial data, the current application of pesticides should be also reviewed and compared to the past practices to avoid proactively that similar mistakes are not repeated. A public awareness campaign on the pesticide problem should be arranged targeting particularly owners of private gardens that appear to be potential source areas in some places. Local farmers could be also reminded about the good-pesticide-practices. Assurance and development of good pesticide practices is also in accordance of Article 10 of WFD.

In recently completed FP6-project Footprint, specific tools for reducing impacts of pesticides in water resources have been prepared. The tools have been targeted for different levels of decision making and end-use and assist to develop measures to reduce the transfer of pesticides to surface or groundwater and their associated impacts. That means that they can support implementation of different measures according Article 11, WFD and more specific trend reversal and limit & prevent measures according to GWD. (http://www.eu-footprint.org/home.html)

The scale of the remediation actions should be determined based on the obtained investigation results. If sustained or significant upward trends in the groundwater bodies are found more extensive, basin-scale activities to reverse the trend are necessary. In any case, local prevention and limitation of the

pollutants to groundwater are necessary to fulfill the underlying requirements of GWD. The Footprint-project included also a review of the pesticide mitigation measures (Reichenberger et al., 2007). Although the overall effectiveness and practical applicability of mitigation measures was assessed, one of the conclusions made is that demonstrates that in terms of contamination and improving water quality, the results of mitigation are very variable and can even be contrasting, depending on climate patterns and locations. Therefore, the measures were labeled as “recommendable” or “non-recommendable” but development of mitigation programs should be based on local investigations and assessments. Accordingly, more concrete suggestions how to organize pesticide mitigation in the Ipoly River Basin are not attempted in this study.
The tools developed in Footprint include also a GIS-based Surface water/Groundwater Contribution Index (SUGAR), which provides useful information about pesticide-related risks, hence of direct support to an update of the WFD Article 5 analyses of pressures and impacts.
Prevention and limiting the spread of the pesticide pollution in groundwater particularly to ecologically sensitive areas and surface water bodies in the Ipoly valley and in other pesticide locations will require remediation of groundwater and polluted soils even if the activities to reverse the trends in whole groundwater bodies turn out to be not necessary. According to Reichenberger, bioremediation methods have been turned out to be both efficient and practically applicable for such purposes. However, cost efficient treatment methods protection of drinking water quality need still to be developed.

8.2.1 Concrete measures

1. Improve co-operation between different levels of administration and expert organizations in municipal, regional and cross-border level.
2. Inventory of the pesticide pollution situation in subsurface (groundwater, unsaturated zone) and in surface water in Ipoly River Basin.
3. Planning remediation actions based on the results of the subsurface pollution mapping.

8.3 Improve protection against nitrate and other nutrient pollution

Nitrate concentrations that exceed the EU-wide quality standard are encountered in groundwater in all study areas. In Bodrog and Ipoly River area nitrates and N-nutrients contribute to the poor quality of the surface water bodies. Since base flow in streams and rives comprises during dry season essentially groundwater, elevated concentrations of nitrates in surface waters may provide an indication on groundwater pollution in the river basin. If such concentrations are observed in the river basin, this should trigger at least, the review of the measures taken under Article 11 of WFD. This means the causes of the possible failure are investigated, relevant permits and authorisations are examined and reviewed as appropriate, the monitoring programmes are reviewed and adjusted as appropriate and additional measures taken as necessary.

In the Aggleteki-Slovakian karst area, nutrients possess a threat to the ecology of the karsts areas, particularly the national parks extending on both sides of the border. (In the Quaternary deposit area, nitrate pollution is induced by locally settlements. The suggested measures are already covered in the previous chapters.)

In order to limit the losses linked to agricultural activities, the main types of actions that the Nitrates directive promotes (in annexes II-codes of good practice, and III-actions programmes) simultaneously concern:

1. Crop rotations, soil winter cover, catch crops, in order to limit leaching during the wet seasons.
2. Use of fertilizers and manure, with a balance between crop needs, N inputs and soil supply, frequent manure and soil analysis, mandatory fertilization plans and general limitations per crop for both mineral and organic N fertilization.

3. Appropriate N spreading calendars and sufficient manure storage, for availability only when the crop needs nutrients, and good spreading practices.
4. "Buffer" effect of non-fertilized grass strips and hedges along watercourses and ditches.
5. Good management and restriction of cultivation on steeply sloping soils, and of irrigation.
6. Cost-efficiency studies on preventive measures should also be encouraged, in order to focus action programmes and practice changes towards the most efficient one.
7. Controlling nitrate emission is primarily the task of transposition and implementation of the "Nitrate" Directive. The nitrate directive requires to limit in the nitrate sensitive areas the application of fertilizes so that the total nitrogen load would be less than 170 kg//ha/a. Environmental subsidies are used as incentives to apply with the regulations. However, in Hungary previous studies have indicated that already 100 kg N/ha/a are enough to increase nitrate concentrations in shallow aquifers above the 50 mg nitrate/l (Vrba, 1988).

Visual observations made during the field trips and fact finding missions carried out in the study areas in October-November 2007 suggest that improving the application winter soil covers and buffer zones can be improved to some extent. Also building of sewage systems of some farms is probably necessary.

However, based on e.g. the soil maps, areas declared as nitrate vulnerable could include areas that contribute to the nitrate pollution in groundwater in variable extent. Also hydrogeological factors such as hydraulic conductivity, capillary fringe etc. and the elevation of groundwater table can contribute to the efficiency of denitrification processes. A revision of the NVZ:s based on soil maps, regional groundwater modeling results, geochemical results and if possible by use of remote sensing methods could help to direct buffering measures and limitations on the use fertilizes in areas that better make the difference. This could give possibilities to authorities to direct the use of financial incentives available to those areas as well. In additions to the implementation of the Nitrate Directive, such are in accordance with Article 10 and 16, WFD.

8.3.1 Concrete measures

1. Promote further the application of the good practices, and the actions programmes laid out under the Nitrate Directive. These will support the implementation of WFD Article 10 and 16.
2. Review of nitrate sensitive zones based on soil maps, regional groundwater modeling results, geochemical results by use of suitable remote sensing methods.

8.4 Protection of quantitative status in Aggleteki-Slovakian karst areas

The observation in the nature protection areas in Aggleteki-Slovakian karst areas suggests that groundwater levels are getting lower. Tot stop or to reverse this trend the hydrology of the modifies surface water bodies need to modified by restoring the functioning of wetlands as flood water storages and by prevention of basal erosion in flow channels. In addition to rehabilitation of previous wetlands, creation of constructed wetlands could provide cost efficient measures to reduce local nitrate problems and eutrophication of surface water. They would reduce the vulnerability of the areas for pollution in general and could be integrated to other development projects as discussed in the previous chapter. These activities would be consistent with the requirements of Article 11 WFD (Supportive measures) and GWD (trend reversal) as explained in Appendix 1.

The population in the area is reducing and also agriculture is already becoming unfeasible e.g. because of the small farm size in the area. At the same time the recreational use e.g. kayaking the rivers is increasing. According to the manager of the Aggleteki National Park, reclamation would improve the ecology and birdlife and consequently help to develop ecoturism in the area. Due to the socio-economic structure, these activities could be supported by programs could receive co-financing from the EU-structural funds. In addition EU’s life program enables purchase or even long-term rents of the land for pilot testing of the wetland restoration projects.

8.4.1 Concrete measures

1. Reclamation of wetlands functioning as a flood water storage (including use of constructed wetlands as local waste water treatment systems).
2. The EU structural and social funds and Life + programme could be suitable financing tool besides national funding.

8.5 Development of limit and prevent programs against industrial and urban point sources

Localized pollution within a groundwater body does not mean in terms of WFD/GWD that the groundwater body does not have a good chemical status. The more widespread the pollution becomes, the more likely the groundwater body will be at poor status.
Therefore, WFD/GWD requires that such localized pollution should be investigated (and remediated if necessary) by prevent or limit measures, which mostly comprise the routine measures carried out by the competent authorities. The specifications for the measures are giving in the Article 6, GWD. These do not give any deadline for complying with the prevent or limit objectives (Article 4,WFD; Article 6, GWD). Prevention and limitation of pollution of groundwater is a continuous process.
However, According to Article 11 of the WFD specifies that, by December 2009, Member States shall establish for each river basin a programme of measures for achieving the WFD Objectives and include them in the RBMPs (also due by the end of 2009). These programmes of measures shall include measures to control point source discharges liable to cause pollution, measures to prevent or control the input of pollutants from diffuse sources that may cause pollution, and a prohibition of direct discharges of pollutants into groundwater (with certain provisions explained in Appendix 1).
Concerning transboundary river basins, the River Basin Management Plans need to be carried out in co-operation with the authorities in Hungary and in Slovakia.
The ENWAT project has included also collection data on about potential or detected pollution sources, and also systematic risk assessments based on the available information (Vrana, 2008). Also geochemical data collected has provided information on the pollution situation in the study areas. The investigations have indicated that there are local pollution problems and also direct and indirect sources of hazardous pollutants (e.g. in unsaturated zone) that may be cause groundwater pollution in future. Evidently, there is a need to continue the characterization of pollution spread and the risks for groundwater resources by more detailed sampling and modeling on both sides of the borders. Co-ordination and implementation of such activities jointly could provide logistical advantages, reduce overlapping activities and lead to savings of time and money. If not a prerequisite then at least a great benefit for integrated water resources management and successful implementation of the WFD, if the direct links and co-operation between regional and even municipal authorities and expert organizations would be improved further and made maintained regular practice. It should be addresses that one of the underlying objectives of WFD is to create a common understanding of activities dealing with the transboundary water resources. Particularly e.g. in management of pollution cases and in crisis situations requiring fast response and actions, it is important that the cross-border authorities are familiar with exchanging information and communicating directly with their transboundary counterparts rather than using high-level representatives as middle-men without a good knowledge of the conditions on field.

8.5.1 Concrete measures

1. Joint projects on characterization of the pollution situation between regional authorites or under their co-ordination.
2. Improvement of communication and information exchange directly between regional and municipal authorites and their counterparts

8.6 Development of waste water treatment and waste management

Concrete measures in all areas should include:

1. controls over the abstraction of fresh surface water and groundwater including a register or registers of water abstractions and water impoundments a requirement of prior authorisation for abstraction and impoundment. These controls must be periodically reviewed and, where necessary, updated. Abstractions or impoundments can be exempted from these controls if they have no significant impact on water status
2. for point source discharges liable to cause pollution, a requirement for prior regulation, such as a prohibition on the entry of pollutants into water, or for prior authorisation, or registration based on general binding rules, laying down emission controls for the pollutants concerned, including controls in accordance with so called "Combined approach" (Article 10) and EU strategies against pollution of water described in Article 16. These controls shall be periodically reviewed and, where necessary, updated
3. for diffuse sources liable to cause pollution, measures to prevent or control the input of pollutants. Controls may take the form of a requirement for prior regulation, such as a prohibition on the entry of pollutants into water, prior authorisation or registration based on general binding rules where such a requirement is not otherwise provided for under Community legislation. These controls shall be periodically reviewed and, where necessary, updated,
4. measures to eliminate pollution of surface waters by those substances specified in the list of priority substances and to progressively reduce pollution by other substances which would otherwise prevent Member States from achieving the Environmental Objectives for the bodies of surface waters,
5. any measures required to prevent significant losses of pollutants from technical installations, and to prevent and/or to reduce the impact of accidental pollution incidents for example as a result of floods, including through systems to detect or give warning of such events including, in the case of accidents which could not reasonably have been foreseen, all appropriate measures to reduce the risk to aquatic ecosystems

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Appendix I. Review of the Water Framework Directive requirements

1 Programme of Measures

1.1 Environmental Objectives

Each Member State are required in Article 11 of Water Framework Directive (WFD) to establish for each river basin district, or for the part of an international river basin district within its territory, a programme of measures based on the results of the analyses required under Article 5 of WFD. These analyses consider the Characteristics of the river basin district, review of the environmental impact of human activity and economic analysis of water use. Such programmes of measures may make reference to measures following from legislation adopted at national level and covering the whole of the territory of a Member State. Where appropriate, a Member State may adopt measures applicable to all river basin districts and/or the portions of international river basin districts falling within its territory.

The Programme of Measures contribute to the achievement of the Environmental Objectives laid out under Article 4 for surface waters, groundwater and for protected areas. Where more than one of the Environmental Objectives relates to a given body of water, the most stringent must be applied.

The Environmental Objectives for surface waters are the following

- to prevent deterioration of the status of all bodies of surface water,
- to enhance and restore all bodies of surface water with the aim of achieving good surface water status and protect and enhance all artificial and heavily modified bodies of water with the aim of achieving good ecological potential and good surface water chemical status at the latest by 2015
- to implement measures aiming to progressively reduce pollution from priority substances and cease or phase out emissions, discharges and losses of priority hazardous substances.

The Environmental Objectives of Member States for groundwater are the following:

- to implement the measures necessary to prevent or limit the input of pollutants into groundwater and to prevent the deterioration of the status of bodies of groundwater, subject to the “Basic measures” (WFD Article 11, paragraph 3),
- to protect, enhance and restore bodies of groundwater subject to the “Basic Measures”, ensure a balance between abstraction and recharge of groundwater,
- to implement the measures necessary to reverse any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity in order progressively to reduce pollution of groundwater.

Environmental Objective for Member States concerning protected areas is

- to achieve compliance with any standards and objectives by 2015, unless otherwise specified in the Community legislation under which the individual protected areas have been established.

Provisions for good status are given in the Annex 5 of the WFD. Conditions when a body of surface water can be defined as artificial or heavily modified water body are also given in the Directive (Article 4, paragraph 3).

The requirements of measures to achieve trend reversal (concerning groundwater bodies) need to be in implemented in accordance with paragraphs 2, 4 and 5 of Article 17. It is also required in WFD that the measures for trend reversal must take into account the applicable standards set out in relevant Community legislation. As already noticed in the preparation phase of WFD, the requirements laid out in Article 17 of WFD required a new directive for groundwater. This Directive established in 2006 is know as Groundwater Directive.

In general, the Environmental Objectives must be achieved by year 2015 (Article 4, paragraph 1). Deadlines may be extended only under the very stringent conditions set out in paragraph 4 of Article 4. In principle, Member States may aim to achieve less stringent environmental objectives for specific bodies of water if impacts of human activities or their natural condition are such that the achievement of these objectives would be infeasible or disproportionately expensive. However, the WFD defines (Article 4) also very clear additional definitions and strict conditions that need to be met before less stringent environmental objectives could be applied. There Directive describes also when the temporary deterioration in the status of bodies of water shall not be in breach of the requirements of this Directive. Also conditions when the failure to achieve good groundwater status, good ecological status or, where relevant, good ecological potential or to prevent deterioration of the status of a water due to new modifications to the physical characteristics of a surface water body or alterations to the groundwater level is not considered to be in breach of WFD.

1.2 Basic Measures

Each programme of measures shall include the "basic" measures specified (Article 11, paragraph 3) and, where necessary, "supplementary" measures.

"Basic measures" are the minimum requirements to be complied with and shall consist of:

- those measures required to implement other Community legislation[1] for the protection of water. (There area at least 11 different EU Directives that deal with water in this context),
- measures deemed appropriate for the purposes to recover costs for water services (WFD Article 9). In short, this means measures take to implement “water-pays-water” and “polluter-pays” –principles,
- measures to promote an efficient and sustainable water use in order to avoid compromising the achievement of the Environmental Objectives,
- measures to meet the requirements of Article 7 which requires, within each river basin district, identification of all bodies of water used for the abstraction of water for human consumption providing more than 10 m3 a day as an average or serving more than 50 persons, and those bodies of water intended for such future use. The measures also include safeguarding their water quality. They should “ensure the necessary protection for the identified bodies of water with the aim of avoiding deterioration in their quality in order to reduce the level of purification treatment required in the production of drinking water”. Member States may establish safeguard zones for those bodies of water. (Monitoring should be carried out those bodies of water, which provide more than 100 m3 a day as an average). Furthermore, for each body of water

[1] The deadline for legislative measures was December 22. 2003 (WFD Article 24)

identified Member States shall ensure that under the water treatment regime applied, the resulting water will meet the requirements of drinking water,

- controls over the abstraction of fresh surface water and groundwater including a register or registers of water abstractions and water impoundments a requirement of prior authorisation for abstraction and impoundment. These controls must be periodically reviewed and, where necessary, updated. Abstractions or impoundments can be exempted from these controls if they have no significant impact on water status,
- controls, including a requirement for prior authorisation of artificial recharge or augmentation of groundwater bodies. The water used may be derived from any surface water or groundwater, provided that the use of the source does not compromise the achievement of the environmental objectives established for the source or the recharged or augmented body of groundwater. These controls shall be periodically reviewed and, where necessary, updated,
- for point source discharges liable to cause pollution, a requirement for prior regulation, such as a prohibition on the entry of pollutants into water, or for prior authorisation, or registration based on general binding rules, laying down emission controls for the pollutants concerned, including controls in accordance with so called "Combined approach" (Article 10) and EU strategies against pollution of water described in Article 16. These controls shall be periodically reviewed and, where necessary, updated,
- for diffuse sources liable to cause pollution, measures to prevent or control the input of pollutants. Controls may take the form of a requirement for prior regulation, such as a prohibition on the entry of pollutants into water, prior authorisation or registration based on general binding rules where such a requirement is not otherwise provided for under Community legislation. These controls shall be periodically reviewed and, where necessary, updated,
- for any other significant adverse impacts on the status of water identified, in particular measures to ensure that the hydromorphological conditions of the bodies of water are consistent with the achievement of the required ecological status or good ecological potential for bodies of water designated as artificial or heavily modified. Controls for this purpose may take the form of a requirement for prior authorisation or registration based on general binding rules where such a requirement is not otherwise provided for under Community legislation. Such controls shall be periodically reviewed and, where necessary, updated,
- a prohibition of direct discharges of pollutants into groundwater that however, can be a subject to the provisions described below,
- measures to eliminate pollution of surface waters by those substances specified in the list of priority substances and to progressively reduce pollution by other substances which would otherwise prevent Member States from achieving the Environmental Objectives for the bodies of surface waters,
- any measures required to prevent significant losses of pollutants from technical installations, and to prevent and/or to reduce the impact of accidental pollution incidents for example as a result of floods, including through systems to detect or give warning of such events including, in the case of accidents which could not reasonably have been foreseen, all appropriate measures to reduce the risk to aquatic ecosystems.

1.3 Schedule for sustainable water-pricing measures

The measures deemed appropriate for the purposes to recover costs for water services have to be implemented by 2010 (WFD, Article 9). By this deadline Member States need to ensure that water-pricing policies provide adequate incentives for users to use water resources efficiently. In addition, the different water uses, disaggregated into at least industry, households and agriculture, need to contribute by this deadline adequately to the recovery of the costs of water services following the polluter pays principle, based on the conducted economic analysis. These need to be carried out according the Annex III of the WFD and if necessary, regarding to the social, environmental and economic effects of the recovery as well as the geographic and climatic conditions of the region or regions affected. The planned implementation steps to be taken to ensure that the water pricing policies contribute to the achievement of the Environmental Objectives and to ensure adequate contributions to the cost recovery of water services need to be described in the River Basin Management Plans. Deviations from the provisions on the water pricing policies and cost recovery by 2010 should be also explained in the RBMPs. However, they cannot compromise the purposes and the achievement of the objectives of WFD.

1.4 Provisions for direct discharges to groundwater

Although direct discharges of pollutants into groundwater are to be prohibited Member States may authorise reinjection into the same aquifer of water used for geothermal purposes. Provided that discharges do not compromise the achievement of the environmental objectives established for that body of groundwater, they may according to Article 11 also authorise (after specifying conditions for):

- injection of water containing substances resulting from the operations for exploration and extraction of hydrocarbons or mining activities, and injection of water for technical reasons, into geological formations from which hydrocarbons or other substances have been extracted or into geological formations which for natural reasons are permanently unsuitable for other purposes. Such injections shall not contain substances other than those resulting from the above operations,

- reinjection of pumped groundwater from mines and quarries or associated with the construction or maintenance of civil engineering works,

- injection of natural gas or liquefied petroleum gas (LPG) for storage purposes into geological formations which for natural reasons are permanently unsuitable for other purposes,

- injection of natural gas or liquefied petroleum gas (LPG) for storage purposes into other geological formations where there is an overriding need for security of gas supply, and where the injection is such as to prevent any present or future danger of deterioration in the quality of any receiving groundwater,

- construction, civil engineering and building works and similar activities on, or in the ground which come into contact with groundwater. For these purposes, Member States may determine that such activities are to be treated as having been authorised provided that they are conducted in accordance with general binding rules developed by the Member State in respect of such activities,

- discharges of small quantities of substances for scientific purposes for characterisation, protection or remediation of water bodies limited to the amount strictly necessary for the purposes concerned

1.5 Supplementary Measures

In order to achieve the Environmental Objectives, "Supplementary" measures need to be designed and implemented in addition to the basic measures. Member States may also adopt further supplementary measures in order to provide for additional protection or improvement of the water bodies for supporting the implementation of WFD or the relevant international agreements. A non-exclusive list given in Part B of Annex VI of WFD is the following:

(i) legislative instruments

(ii) administrative instruments

(iii) economic or fiscal instruments

(iv) negotiated environmental agreements

(v) emission controls

(vi) codes of good practice

(vii) recreation and restoration of wetlands areas

(viii) abstraction controls

(ix) demand management measures, inter alia, promotion of adapted agricultural production such as low water requiring crops in areas affected by drought

(x) efficiency and reuse measures, inter alia, promotion of water-efficient technologies in industry and water-saving irrigation techniques

(xi) construction projects

(xii) desalination plants

(xiii) rehabilitation projects

(xiv) artificial recharge of aquifers

(xv) educational projects

(xvi) research, development and demonstration projects

(xvii) other relevant measures

1.6 Measures if achievement of Environmental Objectives is at risk

Besides listing basic and supplementary measures, Article 11 of WFD describes what should be done if monitoring or other data indicate that the Environmental Objectives for the water body are unlikely to be achieved. Fist of all, the Member State must ensure that:

- the causes of the possible failure are investigated,
- relevant permits and authorisations are examined and reviewed as appropriate,
- the monitoring programmes are reviewed and adjusted as appropriate.
- establish additional measures as necessary.

The additional measures that may include involve stricter environmental quality standards following the procedures laid down in Annex V. Additional measures can be avoided only under similar conditions as when the deadlines for the achievement of Environmental Objectives can be extended, or less stringent environmental objectives applied. However, conditions that would be the result of circumstances of natural cause or force majeure which are exceptional and could not reasonably have been foreseen, in particular extreme floods and prolonged droughts, are hardly happening in practice.

1.7 Other requirements for Programme of Measures

In implementing measures pursuant to the Basic Measures, pollution of marine waters should not be increased. Without prejudice to existing legislation, the application of measures taken pursuant to Basic Measures must not lead, either directly or indirectly to increased pollution of surface waters. These restrictions are set for example to prevent draining or pumping polluted groundwater or waste waters into rivers where they would be diluted (possibly to an "acceptable" level) and eventually ended up into sea. This requirement (Article 11 (6)) aimed to prevent "remediation by dilution" is not applicable however, where it would result in increased pollution of the environment as a whole.

WFD requires that so called "Combined approach" is to be applied to the controls of point and diffuse sources including consequently (Article 10), seepage or discharge of polluted groundwater in to surface water. This means that Member States must by 2012 ensure the establishment and/or implementation of:

- the emission controls based on best available techniques, or
- the relevant emission limit values, or
- in the case of diffuse impacts the controls including, as appropriate, best environmental practices

The best available techniques, relevant emission limit values and best environmental proactices are set out in:

- Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control(19),
- Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment(20),
- Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources(21),
- the Directives adopted pursuant to Article 16 of this Directive,
- the Directives listed in Annex IX,
- any other relevant Community legislation

The deadline for the establishment and/or implementation of the Combined approach by 2012, unless otherwise specified in the legislation concerned.

1.8 The schedule for Programmes of Measures

The programmes of measures shall be established at the latest 2009 and all the measures shall be made operational at the latest 2012. The programmes of measures shall be reviewed, and if necessary updated at the latest 15 years after the date of entry into force of this Directive (2015) and every six years thereafter. Any new or revised measures established under an updated programme shall be made operational within three years of their establishment (Article 11 paragraphs 7-8)

2 Requirements of the river basin management plans

2.1 Scope

River basing management plans describe the key deliverables of the implementation process and the Programme of Measures taken. The plans provide not only a report to the Commission but also means to ensure public participation and integration of all water uses to the planning process.

River basin management plans are produced for each river basin district lying entirely within the territory of Member States. In the case of an international river basin district falling entirely within the Community, Member States shall ensure coordination with the aim of producing a single international river basin management plan. Where such an international river basin management plan is not produced, Member States shall produce river basin management plans covering at least those parts of the international river basin district falling within their territory to achieve the objectives of this Directive.

If a Member State identifies an issue during the planning and implementation of Programmes of Measures, that has an impact on the management of its water but cannot be resolved by that Member State, it may report the issue to the Commission and any other Member State concerned and may make recommendations for the resolution of it.

If an international river basin district extends beyond the boundaries of the Community, Member States shall endeavour to produce a single river basin management plan, but where this is not possible, the plan shall at least cover the portion of the international river basin district lying within the territory of the Member State concerned (Article 12). The Commission shall respond to any report or recommendations from Member States within a period of six months.

2.2 Contents of RBMP's

The river basin management plan shall include the information detailed in Annex VII. River basin management plans shall cover the following elements:

RBMP will give a general description of the characteristics of the river basin district including maps of the location and boundaries of surface water and groundwater bodies, the ecoregions and surface water body types within the river basin and identifying the reference conditions for the surface water body types.

RBMP will also summarize significant pressures and impacts of human activities on the status of surface water and groundwater, the land use in the basin (map) and the results of the economic analysis of water use. It will also include estimations of point source and diffuse pollution, pressures on the quantitative status of water including abstractions and analysis of other impacts of human activity on the status of water. The plan must give a table and maps of any protected areas located in the river basin and maps of the established monitoring networks and a presentation in map form of the results of the monitoring programmes (for surface water, groundwater and protected areas).

The environmental objectives relevant for surface waters, groundwaters and protected areas in the river basin must be listed. The plan must also include description of the conditions and justifications if requests for extension of deadlines, less stringent objectives are applied or why temporary deteriorations in statuses results of new modifications surface water or groundwater conditions should not be considered to be in breach of WFD.

The programme or programmes of measures adopted under Article 11, that is the Basic, Supplementary and possible additional measures need to be summarized in RBMP. An explanation should be included to the summarry how these measures serve the achievement of the Environmental Objectives for the water bodies and/or protected areas in the basin must be described. Besides this summary, RBMP must give additional information also on several issues described below.

The Plans need to give also more information on the activities (carried out as Basic measures) including

- a summary of the economic analysis of water use,
- a summary of the measures required to implement Community legislation for the protection of water,
- a report on the practical steps and measures taken to apply the principle of recovery of the costs of water use,
- a summary of the measures taken to meet the requirements of Article 7,
- a summary of the controls on abstraction and impoundment of water, including reference to the registers and identifications of the cases where exemptions have been made,
- a summary of the controls adopted for point source discharges and other activities with an impact on the status of water,
- an identification of the cases where direct discharges to groundwater have been authorised,
- a summary of the measures taken in accordance with Article 16 on priority substances,
- a summary of the measures taken to prevent or reduce the impact of accidental pollution incidents.

The plans need to give also a summary clarifying the measures taken for those bodies of water which are unlikely to achieve the Environmental Objectives and details of the supplementary measures identified as necessary in order to meet the environmental objectives established. Furthermore, details of the measures taken to avoid increase in pollution of marine waters in accordance with Article 11(6). Also a register of any more detailed programmes and management plans for the river basin district dealing with particular sub-basins, sectors, issues or water types need to be given, together with a summary of their contents and a summary of the public information and consultation measures taken, their results and the changes to the plan made as a consequence. Finally, the plan needs to give a list of competent authorities in accordance with Annex I. The list of competent authorities has been however already compiled because (Article 24) Member States were required to bring into force the laws, regulations and administrative provisions necessary to comply with this Directive at the latest 22 December 2003. This included the identification of the competent authorities (Article 3(8) and Article 24).

River basin management plans shall be ready by 2009. The Planning is however a continuous and iteratively reviewed process. The first review and update must be ready at the latest 2015 and repeated every six years thereafter.

2.3 The updates of RBMP's

The first update of the river basin management plan and all subsequent updates shall also include:

- a summary of any changes or updates since the publication of the previous version of the river basin management plan;
- an assessment of the progress made towards the achievement of the environmental objectives, including presentation of the monitoring results for the period of the previous plan in map form, and an explanation for any environmental objectives which have not been reached;
- a summary of, and an explanation for, any measures foreseen in the earlier version of the river basin management plan which have not been undertaken;
- a summary of any additional interim measures adopted under Article 11(5) since the publication of the previous version of the river basin management plan.

River basin management plans may be supplemented by the production of more detailed programmes and management plans for sub-basin, sector, issue, or water type, to deal with particular aspects of water management. Implementation of these measures shall not exempt Member States from any of their obligations under the rest of WFD.

2.4 Public information and consultation

Implementation of WFD and preparation of the RBMP's particularly, is intended to be a transparent process and involve a strong public participation. Therefore, Member States must encourage the active involvement of all interested parties in the implementation of WFD. For each river basin district, Member States must publish and make available for comments to the public, including users to following:

- a timetable and work programme for the production of the plan, including a statement of the consultation measures to be taken, at least three years before the beginning of the period to which the plan refers;
- an interim overview of the significant water management issues identified in the river basin, at least two years before the beginning of the period to which the plan refers;
- draft copies of the river basin management plan, at least one year before the beginning of the period to which the plan refers.

On request, access must be given to background documents and information used for the development of the draft river basin management plan.

Member States must allow at least six months to comment in writing on those documents in order to allow active involvement and consultation (Article 14).

2.5 Reporting

1. Member States shall send copies of the river basin management plans and all subsequent updates to the Commission and to any other Member State concerned within three months of their publication:

(a) for river basin districts falling entirely within the territory of a Member State, all river management plans covering that national territory and published pursuant to Article 13;

(b) for international river basin districts, at least the part of the river basin management plans covering the territory of the Member State.

2. Member States shall submit summary reports of:

- the analyses required under Article 5, and

- the monitoring programmes designed under Article 8

undertaken for the purposes of the first river basin management plan within three months of their completion.

3. Member States shall, within three years of the publication of each river basin management plan or update under Article 13, submit an interim report describing progress in the implementation of the planned programme of measures.

Appendix II. Current environmental planning practices in Finland

(Extract from: Leveinen, J. & Kaija, J. (edited). 2007.)

4 Current environmental planning practices for groundwater and aggregate in Finland

4.1 Brief introduction to the Finnish planning system

The Finnish administrative structure relies on three levels: national, regional and local. The central government in Finland consists of the Council of State, which includes the cabinet and 12 ministries. Legislative power rests exclusively with the central government. There are six provinces in Finland that belong to the state system and are purely for the purposes of central government administration. The 19 Regional Councils in Finland, which are associations of municipalities, have authority for regional development and are responsible for regional policy and planning. On a local level, there are 431 self-governed municipalities in Finland (situation in the beginning of year 2006). The municipalities have in common the basic administrative and decision-making system. They are responsible for organizing health and social security, education, youth work and land use planning in their area. The Åland islands (Ahvenanmaa islands) – situated between Finland and Sweden – form an autonomous, demilitarized and unilingual Swedish province in Finland. Their self-government status is stated in the Finnish constitution (based on Jarva & Virkki, 2006)

Land use planning in Finland is regulated mainly by the Land Use and Building Act (*Maankäyttö- ja rakennuslaki 132/1999*). More detailed regulations and controls on land use and construction are included in the Land Use and Building Decree (*Maankäyttö- ja rakennusasetus 895/1999*). The National Building Code contains regulations and guidelines that complement the legislation in the Land Use and Building Act. Other legislation that steers the land use planning is for example the Nature Conservation Act (*Luonnonsuojelulaki 1096/1996*). The common objectives of the Land Use and Building Act are to organise land use and construction to create the basis for high quality residential environments, to promote ecologically, economically, socially and culturally sustainable development, to ensure that everyone has the chance to participate in open planning process and to guarantee the quality of planning decisions and solutions.

The principal instruments of the Finnish planning system are national land use guidelines, regional plans, local master plans and local detailed plans. On a national level, the Ministry of Environment supervises and develops planning policy in Finland. Regional Councils are in charge of regional scale spatial planning (*maakuntakaava*) and the municipalities are responsible for preparing a local master plan (*yleiskaava*) as well as a local detailed plan (*asemakaava*) for their area. These three separate spatial plans have been developed to serve different aims and purposes. The regional plan concentrates on land use issues that are of national or regional interest (usually in scale 1:100 000-1:250 000). The local master plan takes into account the special needs of a municipality (usually in scale 1:5 000-1:50 000) and the local detailed plan guides building and planning within the municipality (usually in scale 1:2 000). In the hierarchical system, the regional plan steers the local master plan and the local master plan steers the local detailed plan. However, the legal effects go in the other direction. It means that the more detailed plan, if it exists, has to be followed, e.g. if a local detailed plan exists it has more power than a local master plan and if a local master plan exists it has more power than a regional plan. Every municipality also needs to have a building code (*rakennusjärjestys*), which guides planning on the local level. The building code includes regulations that are necessary for the realisation and preservation of a good living environment. (based on Jarva & Virkki, 2006)

Plans for shore zones have been drawn up since the 1960's. In 2003, 15 % of shore zones had either a local (shore) detailed plan or local (shore) master plan (Jylhä & Riipinen, 2003). The Land Use and Building Act states (*Maankäyttö- ja rakennuslaki 10/72§*) that *"buildings may not be constructed in shore zones in shore area of the sea or of a body of water without a local detailed plan or legally binding local master plan. […] These provisions also apply to shore areas where planning of building and other use to arrange for holiday homes which are mainly shore-based is necessary because of anticipated building development in the area."* Master plans for water management

4.2 Master plans for water management

Since 1960ies, municipalities have played the primary role in the development and implementation of water services, which cover by legal definition, both water supply and waste water treatment. The responsibilities of municipalities have been further clarified in the Water Services Act (Vesihuoltolaki 119/2001) adopted in 2001. This piece of legislation also addresses the role of master planning of water services on two levels. Regional level plans called "vesihuollon yleissuunnitelmat" cover the extent of provinces or groups of municipalities. Local level plans *i.e.* "vesihuollon kehittämissuunnitelmat" cover the area of a municipality or a certain part of it. The decrees of national legislation take into account also the EU:s Water Framework Directive (WFD) that requires general water planning to be made in a river-basin scale. The Integrated River Basing Management Plans, which are made as a part of WFD-implementation and the water services plans as well as land use plans must be made mutually consistent.

Regional level plans are in general organized (publicly bid) by *e.g.* the Regional Councils or Regional Environmental Centers. Since municipalities are responsible bodies for organizing and developing water supply and wastewater treatment in their areas, they are also required to carry out local level water services planning. Consequently, the preparation of local level plans is organized directly by the municipalities or municipally owned water works companies. Municipalities are also required to participate to the inter-municipal water planning.

Regional plans have become the central instrument for cross-municipal-border co-operation and development of water services for several reasons. In many cases, organization and financing of water supply could not be done without inter-municipal co-operation. The sand and gravel aquifers as well as suitable surface water sources in general are spatially unevenly distributed. Therefore, many municipalities lack sufficient water resources available with in their cadastral area. In addition, most of the Finnish municipalities are small and have difficulties to finance costly investments. Financial benefits that can be likely reached through technical co-operation between municipalities will be more than welcomed. In addition, municipalities can also trade water services and achieve significant income.

Especially when financially difficult and long-lasting commitments need to be made in the participating municipalities a general plan of the foreseen technical solutions becomes in practice mandatory before any political and administrative decisions on the inter-municipal co-operation can be made.

For the cases when municipalities may not wish to co-operate with their neighbors due to conflicting interests, the current legislation gives authorities efficient incentive to promote inter-municipal co-operation and consequently, the preparation of regional plans. Finnish municipalities can collect service fees and tax income from their citizens. However, municipalities also compete about taxpayers with the services that they can provide to them. As a result, municipalities may have conflicting interests in developing water supply or wastewater management. Nevertheless, they can receive financial investment support from the state or EU for developing water services if they attach their application with a suitable plan. In practice, such plan must be done according to the guidelines for the regional master planning (Vikman and Santala, 2001).

4.2.1 Planning process

Irrespective of the planning scale, the preparation always involves stakeholder participation. The stakeholders should always represent an area that is "larger than the planning area". This means that e.g. stakeholders of a local, municipal plan should involve representatives from the neighboring communities; regional scale planning should involve also authorities and regional administration of the surrounding areas etc. Stakeholders can be represented in the drafting committee or they can be asked to give comments/statements on the plan text or on the scenarios underplaying the plan. These typically involve estimates on water consumption based on socio-economic prognoses, or developments in environmental situation *etc.*

The co-ordination is carried out or at least a key role is played by a Regional Environmental Centre whose duties include the promotion and preparation of regional land use plans and who comprise the regional authority on environmental monitoring.
The planning committee typically includes 6-7 persons with relevant substance experience. A steering committee may be established to include higher-level decision makers or stake holder groups.

The text and particularly the summary should be clear and understandable to non-experts so that a layman reader can comprehend the prognoses and assumptions made, the suggested responses and their possible consequences. The drafting the plan text and map illustrations is carried out usually by a consultant selected after a tender process based on the previous references and the price of their bid.

The planning and the implementation processes shown in Figure 2 can be considered as a cyclic procedure that will be repeated after 5-10 years. The plan is supposed to provide an expert opinion on the most feasible actions to be taken in the implementation period as a response to the different scenarios (Figure 3). The time frame of the underlying scenarios is typically longer. For example, the water demand is typically estimated separately for urban and rural areas and industries typically for the next 10-20 years.

However, the plan needs to take into account for example area reservations in land use plans that can cover next 200/500 years or more. According to the national legislation, water services include also wastewater treatment. Threfore, production of waste water and solid slurry waste will be assessed. Depending on the hydrological conditions, scenarios should take into account the preparedness to flood and drought situations based on existing historical data (few tens of years, few hundred years maximum). The underlying scenarios must take into account the objectives of national and EU-level programs *e.g.* Water management 2010 or EU-WFD, the latter of which assumes that a good qualitative and quantitative status of water resources should be reached 2015 and requires reduction the risks of groundwater pollution.

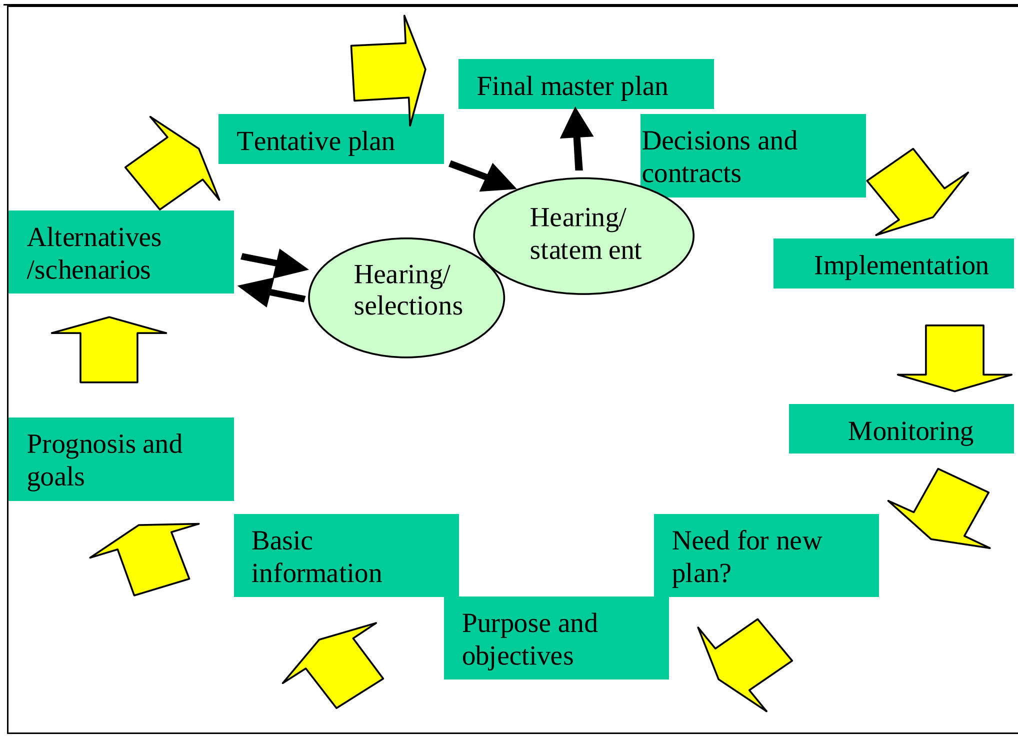


Figure 2. *An illustration of the planning process as described in Ympäristöopas 88 (Environmental guideline) by Finnish Environment Institute (Vikman and Santala, 2001). The process is in principle continuous cycle the need for plan will be evaluated in 5-10 year cycles.*

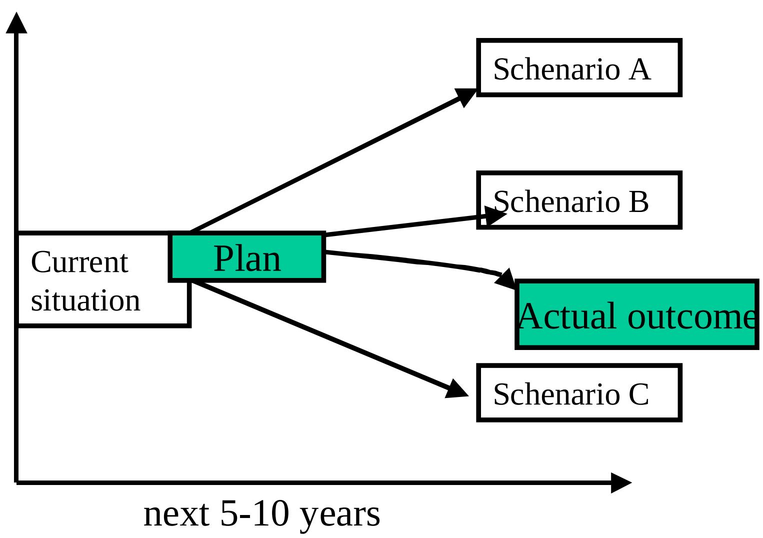


Figure 3. *Time frame for the master plan implementation. Modified from Ympäristöopas 88 (Environmental guideline) by Finnish Environment Institute (Vikman and Santala, 2001).*

4.2.2 Outputs of the planning process

The planning process produces several reports and documents. In order to become accepted by authorities, stakeholders and the public, the plan needs to be prepared transparently. Therefore the planning program is commonly described in a separate report. The basic information collected for the plan is commonly documented at least as work documents. However, this information is commonly included into a separate report describing the planning objectives and the relevant prognosis of population, industry and water demand *etc*. Particular attention should be paid to the documentation of the different planning alternatives and scenarios, which will be represented for evaluation and comments to different stakeholders. After the comments to the scenarios have been received, a tentative master plan comprising report and map attachments will be compiled. This will be exposed again to stakeholder and in many cases also to public for their comments that will be also documented. Hearings may lead to several clarifications before the final master plan is achieved. The final version of the plan is comprises commonly a short document and generic thematic maps targeted not only to experts of water sector but also to the public as well.

4.2.2.1 Relevant background information

The background information to be collected for water services development concerns both drinking water supply and wastewater management. The different scenarios need to rely on relevant socio-economic statistics and prognoses on the developments of population, industries, business lines and sources of livelihoods in the area. The plans need to take into account the current land use and land-use plans, the existing plans for water management and protection must be described and considered. The development plans must be consistent with all the relevant court decisions and environmental permissions and agreements between municipalities on water management. Preparation committee needs to be concerned about relevant ongoing court-decision processes. It is evident that the above goals cannot be reached without interdisciplinary co-operation and expertise, transparent preparation process and involvement of different stakeholders.

The collected information also includes description of the water service sector; organizations and their co-operation in the planning area. Description should include the current situation with the water works companies including operational costs, development plans and preparation plans for water shortages. Similarly current situation of the waster water treatment facilities and their operational costs need to be provided and the planned responses to water surplus situations (floods, heavy rain etc.) need to be included.

Water use statistics that will be collected from local water works companies for specifies the statistical trends of urban and rural population as well as industries. Also characteristics and timing of peak and low consumption will be defined for different user groups. For example, consumption of industrial raw waters and production of wastewater may take place in summer time when groundwater levels are low. Consumption of potable water and wastewaters by local residence can depend on socio-economic structure.

The guidelines for the planning process address many human activities that are at least indirectly depended on geology and hydrology. Therefore, the Guidelines also require that the plans need to be attached with maps of watercourses and geology (soil cover). In addition, data collected and reported must include description of groundwater resources in terms of quantity and quality, vulnerability and pollution risks, current and planned use and impact assessments. Also relevant surface water bodies need to be described in terms of hydrological characteristics and water quality and any estimates of nutrient and pollution loads and impact assessments. Available summaries of operation and monitoring reports should be provided.

Evidently, efficient management of all the necessary spatial data and text documents would require development of a GIS-system.

4.3 National land use guidelines

The Finnish Council of State sets the national land use guidelines. They outline Finland's land use far into the future. The valid guidelines were set in November 2000. The guidelines indicate which issues should be taken into account all over the country in all land use and land use planning. Under the Land Use and Building Act, regional planning, planning at the local level, and the activities of government authorities should promote the implementation of these guidelines (Ministry of the Environment, 2002).

The national land use guidelines have been grouped according to subject as follows: 1) a well-functioning regional structure, 2) a more coherent community structure and a quality of the living environment, 3) the cultural and natural heritage, recreation uses and natural resources, 4) well-functioning communication networks and energy supply, 5) special issues of the Helsinki region and 6) areal entities of outstanding interest as natural and cultural sites (Ministry of the Environment, 2002).

4.4 Spatial planning on the regional level

Regional Councils, that are joint municipal boards, are responsible for preparing a regional plan (*maakuntakaava*) for their area. The regional plan covers usually the whole region. It is also possible to make a regional plan of a smaller part of the region or it can be prepared in stages, divided into several themes. The aim is to end up with one regional plan that covers all themes and the region as a whole.

The required content of the regional plan is provided in the Land Use and Building Act (*Maankäyttö- ja rakennuslaki* 4/28§). “In planning, special attention shall be paid to following: 1) the appropriate regional and community structure of the region; 2) ecological sustainability of land use; 3) environmentally and economically sustainable arrangement of transport and technical services; 4) sustainable use of water and extractable land resources; 5) operating for the region’s business; 6) protection of landscape, natural values, and cultural heritage; and 7) sufficient availability of areas suitable for recreation.

Regional planning process includes also regional development strategies drawn up by the Regional Councils for 20-30 years. These strategies are concretized in regional plans that are drawn up for 10-20 years. Regional programmes are prepared for 3-5 years. They define more precisely the long-term regional development strategies.

Regional plans are fairly general plans set out medium-term and long-term objectives for regional land use patterns concerning issues that affect land use planning in many municipalities (Ministry of the Environment, 2005). The Assembly of the Regional Council, which is the Regional Council’s highest decision-making body, approves the regional plan. After approval, the regional plan is submitted to the Ministry of the Environment for ratification and legal effects.

Preparing a regional plan is quite a complex planning-, interaction- and decision-making process. Every phase of the process includes participation, impact assessment, decision-making and actual planning. The planning process can be divided roughly into seven different phases: start-up, objectives, preparation, draft, approval, ratification and follow-up phase.

4.5 Spatial planning on the local level

Municipalities are responsible for preparing a local master plan (*yleiskaava*) for their area. It can cover the whole municipality or it can be drawn up in stages or by sub-area. Neighboring municipalities can also co-operate and prepare a joint municipal master plan. The local master plan is usually drawn up by the local authority, that is municipality, and is approved by the local elected council. However, the task of preparing a joint municipal master plan can be delegated to some suitable joint organization of local authorities, e.g. to the Regional Council. The joint master plan needs to be ratified by the Ministry of the Environment.

The required content of the local master plan is provided in the Land Use and Building Act (*Maankäyttö- ja rakennuslaki* 5/39§). "The following must be taken into account when a local master plan is drafted: 1) the functionality, economy and ecological sustainability of the community structure; 2) utilization of the existing community structure; 3) housing needs and availability of services; 4) opportunities to organize traffic, especially public transport and non-motorized traffic, energy, water supply and drainage, and energy and waste management in an appropriate manner which is sustainable in terms of the environment, natural resources and economy; 5) opportunities for a safe and healthy living environment which takes different population groups into equal consideration; 6) business conditions within the municipality; 7) reduction of environmental hazards; 8) protection of the built environment, landscape and natural values; and 9) sufficient number of areas suitable for recreation."

Municipalities prepare also local detailed plans (*asemakaava*) for their area. A local detailed plan can cover a whole residential area including housing, work and recreation areas or sometimes a smaller area. The local detailed plan is approved by the local council.

The required content of the local detailed plan is provided in the Land Use and Building Act (*Maankäyttö- ja rakennuslaki* 7/55§). "The local detailed plan shall be presented on a map indicating the following: 1) the boundaries of the area covered by the local detailed plan (local detailed plan area); 2) the boundaries of the various areas included in the local detailed plan; 3) the public and private uses intended for land and water areas; 4) the volume of building; and 5) the principles governing the siting of buildings and, when necessary, the type of construction."

4.6 Natural resources in land use planning

The national land use guidelines state that *"land use should promote the sustainable use of natural resources so as to secure their availability for future generations as well. In land use and its planning, the location of natural resources and the possibilities of utilising them are to be taken into account"* (Ministry of the Environment, 2002). In terms of sustainable use of natural resources, usable bedrock resources, their consumption and long-range needs as well as mires suitable for turf extraction and their needs for production and protection should be taken into account in regional planning. The need for protecting groundwater and surface waters and the needs for using them should also be taken into account in land use planning (Ministry of the Environment, 2002).

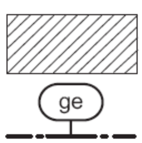
The regional development strategies are often written in very general level but they follow the principles defined by the national land use guidelines. The regional programme is more detailed and it includes for example impact assessment studies where among other things the impacts on nature and on natural resources are studied (*Maankäyttö- ja rakennusasetus* 1/1§). In the case of natural resources, the important groundwater areas as well as extractable sand, gravel and bedrock areas are defined in the regional plan. It is important to reserve areas and to ensure both the supply of good quality aggregate for construction (*e.g.* for the concrete industry and highway construction) and good quality groundwater for water supply systems within the regional plans. The description of the regional plan gives detailed information on natural resources of the area, *i.e.* how many important groundwater areas there exist, what is the quantity and quality of extractable sand, gravel and bedrock resources as well as estimated future use and it can also give information on specific conditions that should be taken into account.

Regional plan commits on the environmental management and post-treatment of the extraction areas. There are many different ways in which former extraction areas can be developed. Silviculture is the most common alternative. Other possibilities include recreation and sports, housebuilding and industrial use. Hard rock quarries can even be suitable for construction of refuse disposals. Parts of some extraction sites may also be used as educational sites for science classes (Alapassi *et al.* 2001). The objectives of the environmental management and post-treatment actions of the extraction areas are presented in the regional plan.

Land Extraction Act (*Maa-aineslaki 1981/555*) defines how to apply permission to extraction of land resources. The permission is granted by the authority that municipal has issued. The statement is needed from the Regional Environment Centre if the planned land extraction area has national or other significant importance in terms of nature conservation, significance in terms of water protection or it directly effects on other municipal.

4.7 Symbols used in the land use plans

The Ministry of the Environment has published 13 separate guides for implementing the Land Use and Building Act (Maankäyttö- ja rakennuslaki 2000 -sarja / Land use and Building Act 2000 -series). There exist specific guides to symbols that should be used in land use plans in different planning levels. In the following, some symbols related to the land extraction and water supply are presented and shortly explained.



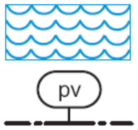
Arvokas harjualue tai muu geologinen muodostuma.

Valuable esker or other geological formation

Arvokas kallioalue, jolla on merkittäviä geologisia/ biologisia/maisemallisia ar-voja. Alueen luonnonarvoja vaarantavat toimenpiteet ovat kiellettyjä.

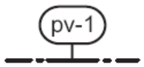
Valuable bedrock area with significant geological/biological/scenery values. The actions that could endanger the natural values are forbidden

This symbol is used to indicate the valuable and significant geological formations, such as eskers, drumlins, ice margins and bedrocks in the land use plan. The basis to take these areas into account in land use planning is on geological, biological and scenery values of the formations. Within these areas the consideration of a permit for land extraction should be followed to avoid damaging the valuable landscape etc. The key text to the symbol, or the plan regulations should give detailed information on the values that are meant to be protected.



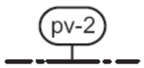
Tärkeä (I) tai vedenhankintaan soveltuva (II) pohjavesialue.

Groundwater area important for water supply (I) or suitable for water supply (II)



Vedenhankinnalle tärkeän pohjavesialueen raja.

Boundary of groundwater area important for water supply (I)

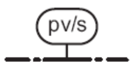


Vedenhankintaan soveltuvan pohjavesialueen raja.

Boundary of groundwater area suitable for water supply (II)

Muu pohjavesialueen raja.

Boundary of other groundwater area (III)



Vedenottamon lähi-/kaukosuojavyöhykkeen raja (vesioikeuden päätös ...)

Boundary of groundwater protection zone

This symbol indicates the important groundwater areas for water supply and their classification according to their priority; class I: groundwater area important for water supply; class II: groundwater area suitable for water supply; class III: other groundwater area (indication of groundwater areas that belong to the class III is optional). The water intakes are marked with symbol. The protection zones of the groundwater areas that are based on the Water Act (*Vesilaki 264/1961*) regulations are indicated with letters pv/s and the delineations is drawn to the land use plan.

Maa-ainesten ottoalue.

Area reserved for land extraction

Maa-ainesten ottoalue, joka ottamisen päätyttyä varataan teollisuus- ja varastorakennusten korttelialueeksi.

Land extraction area that will be turned into industrial area after extraction has been finished

This symbol indicates the areas that are reserved for the land extraction in the land use plan. However, the extraction of land resources in these areas needs permit like regulated in the Land Extraction Act.

It is also recommended to indicate the post-treatment actions of the area already in the land use plan.

Ympäristö- tai maisemavaurion korjaustarve.

Need for environment or landscape treatment

This mark is used to indicate the specific need for environment or landscape treatment. For example, the old land extraction areas that are insufficiently post-treated can be indicate with this symbol in the land use plan.

4.8 Other relevant plans

As it is said before in this report the national land use guidelines state, that *"land use should promote the sustainable use of natural resources so as to secure their availability for future generations as well. In land use and its planning, the location of natural resources and the* *possibilities of utilising them are to be taken into account"* (Ministry of the Environment, 2002). In terms of sustainable use of natural resources, usable bedrock resources, their consumption and long-range needs should be taken into account in regional planning (Ministry of the Environment, 2002).

Different kinds of explorations have been operated in SE Finland by GTK to define usable bedrock resource areas for natural stones and hard rock aggregates among others. Natural stone exploration projects were carried out in Kymenlaakso region 1996-1997 and in South Karelia region 1998-2000. And respectively hard rock aggregate exploration projects were carried out in Kymenlaakso region 2000-2002 and in South Karelia region 2004-2006. Principles in both exploration projects (natural stone and hard rock aggregates) were to explore all bedrock outcrops, which were not nearer than 500 m to a house or any kind of building and had not any environmental protection options. Distance to a lake should be over 200-300 m.

Natural stone exploration project in Kymenlaakso region was not overarching due to available time and money. As a result of the project quite large potential areas for natural stone production were defined but on the other hand only a few prospect areas. The result of the project could be useful for regional scale land-use planning. But in South Karelia the same kind of project was carried out more detailed and more prospect areas were defined. The results from South Karelia could be more useful for regional land-use planning, because there are determined prospect scale areas and not so large potential areas. The results of both projects have been reported (Härmä and Selonen 2000, Härmä 2001).

Hard rock aggregate exploration projects in Kymenlaakso and South Karelia regions have been a part of POSKI –projects (The Adjustment of Groundwater Protection with Aggregate Service). The objective of these projects was to produce relevant information on the protection needed in sand, gravel and bedrock formations, the amount of aggregate and quality of the formation and their suitability for water or aggregate supply. The results of these projects are very useful in regional land-use planning but they are proposals and do not have any juridical obligations for authorities and landowners.

Hard rock aggregate explorations do not cover evenly the Kymenlaakso or South Karelia districts. The bedrock consists quite widely of different types of rapakivi granites that were not so precisely explored as the bedrock outside of rapakivi granites. The results of Kymenlaakso region have been reported (Keskitalo (ed.) *et al* 2004), and the report of South Karelia region will be published in 2007.

The exploitation areas of hard rock aggregates and areas suitable for natural stone production could be inserted in regional land-use plans and some Regional Councils have decided to insert these areas to their regional land-use plans, but possibly every Regional Councils will not do so. Areas reserved for rock aggregate and natural stone extraction could be presented in regional land-use plans with a symbol:

Area reserved for land extraction

or with a symbol

EOk = Area reserved for hard rock aggregate extraction.