MINISTRY FOR ENVIRONMENT AND WATER

Guide

GROUNDWATERS IN HUNGARY

II.

REMEDIATION PROGRAMME

GUIDE

GROUNDWATERS IN HUNGARY
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compiled by the Water Management Directorate of VITUKI Environmental Protection and Water Management Research Institute on behalf of the Ministry for Environment and Water

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INTRODUCTION

The various kinds of groundwater are natural resources of outstanding importance in Hungary. More than 97 per cent of drinking water is supplied from groundwater. Springs and wells are filling up the swimming pools in the numerous thermal and medicinal baths. Groundwaters are utilized in the industry and for irrigation as well however to a smaller extent and no extension is justified. Nevertheless the significance of groundwater is high in terms of natural vegetation and agriculture as well: for the optimal water supply of vegetation an appropriate depth of groundwater table is essential. There are several nature conservation areas of special importance in our country where the wetness migrating upwards from the deeper horizons is providing the sine qua non for special ecosystems. Captured or non-captured natural springs may represent special natural values as well. Their water or the groundwater infiltrating into riverbeds ensure that several small watercourses do not dry up in seasons without precipitation.

Climate changes, human interventions, overuse of the resources and the various pollution sources are causing several problems in groundwater management and protection. In Hungary groundwater is owned by the state; at the same time municipalities responsible for water supply, water users, those who perform activities generating pressure on or polluting the environment and after all individual citizens all have their tasks in the preservation of the good quantitative and qualitative status of groundwater.

Groundwater should be protected not only in itself but also as a part of the system of environmental elements. From this point of view the protection of the geological medium, especially that of soil is of outstanding importance. The Hungarian legislation takes this into account as one of the firsts in international aspect as well.

The manifold utilization of freshwater resources and among them that of groundwater without deteriorating their good status is one of the worldwide accepted objectives of sustainable development and is recommended by international organizations. The Water Framework Directive of the European Union confirms this approach as well. The Hungarian water and environmental legislation regulates the utilization and protection of groundwater in the same spirit.

The appropriate orientation is essential for the national environmental, water, geological, public health and educational organizations responsible for groundwater, as well as for local governments, researchers, consultants, operators, and all citizens in their own domains to share a uniform approach in the utilization and protection of groundwater resources in conformity with the environmental objectives and public welfare. The objective of the present publication is to present a general picture on the several types of groundwater in Hungary, on the possibilities of their utilization and protection, on the relevant legislation, on the organizations dealing with groundwater, on the information available and their accessibility.

The present publication is the amplified and modified edition of the guide published by the VITUKI Ltd. commissioned by the Ministry of Environment in 2002. Re-edition was made essential by new information relating to groundwater originating from the work carried out in the last 3 years, – mainly in compliance with the EU Water Framework Directive – as well as by the significant changes in the relevant organizations and legislation.

GROUNDWATER IN HUNGARY

Groundwater types

– *A considerable part of Hungary, located in the centre of the Carpathian Basin, is of flat and hilly character. In this basin-type area marine and fluvial deposit, sometimes several kilometres thick, covers the older rocks. The marine deposits situated at larger depth are mainly clays and clayey marls with a very low potential yield for water extraction. As the Pannonian Sea turned into an inland lake inflowing rivers deposited coarser sediments of a thickness sometimes up to 1 to 2 km: in the geological profile of that time there are already several sand and sandstone layers (**Figure 1.**). In the Quaternary exclusively the fluvial sedimentation was already characteristic, with silty, sandy and gravel deposits. The thickness of these complexes is also near 1 km in the Kisalföld and in the southern region of the Great Hungarian Plain. At the border of the basin river fans contain much gravel with a thickness of only some ten meters, except for the Szigetköz region where gravel layers are as thick as several hundred meters. Some parts of our rivers are running in these formations and their water is in direct contact with that of the gravel layers.*

The good aquifers are the coarser sandy and gravel layers of the **clastic basin-deposits**. At larger depth one can find sandstone instead of the loose sandy layers. These aquifers can be found in more than three quarter of the country's area assuring everywhere the chance for local drinking water production and from greater depths (usually more than 500 m) the abstraction of thermal water. With wells bored into the shallow gravel aquifers along the riverbanks the filtered water of the river i.e. **bank-filtered water** is produced (**Figure 23.**). The upper layers down to the depth of 10 to 20 m are of fine-grained formations enabling only small discharges for local production. The majority of dug wells in the villages and countryside homesteads are producing water from such formations. However at some sites these formations may have better productivity. In this publication water located in the deposits near the surface is called (acc. to the specific Hungarian nomenclature) **shallow groundwater** (in other languages this terms stands usually for groundwater in general), water in deeper clastic sediments is called **deep groundwater**, while the deep groundwater of a temperature higher than 30 °C are **thermal deep groundwaters**, being a type of thermal waters.

The other main type of groundwater aquifers is the group of **karstic rocks** that can be found in almost the half of the hilly areas covering one fifth of Hungary's territory. These calciferous marine sediments of the Mesozoic (limestones, dolomites) often have a high conductivity along faults, fractures and holes widened by water of high carbonic acid content during the process of karstification. Precipitation infiltrates mainly directly and quickly into the outcropping karstic rocks ("open karst"), therefore the recharge of **karstic waters** is good. In several areas karstic formations are covered by geological formations of low conductivity also in the hilly regions, while at the margins of such territories the karstic reservoir is often covered by clastic sediments of large (sometimes several km) thickness, generally impermeable, lying directly above the karstic formations (covered karst). In the karstic formations at the margins of mountains and in large depth below the surface in the basin-regions thermal waters can be found, part of which comes to the surface in the form of the well known **thermalkarst springs** (Héviz, Budapest, Eger, etc.).

Beyond the main groundwater types set forth above (bank-filtered, shallow-, deep groundwaters and the karstic waters) water can be exploited, although to a smaller extent, from **other geological formations** as well. Parts of the hilly regions are built up of non-karstic rocks (crystalline, volcanic or sedimentary formations of lower yield) from which smaller springs, significant only for local extraction, arise.

Water bearing formations in Hungary
(without geothermal aquifers)

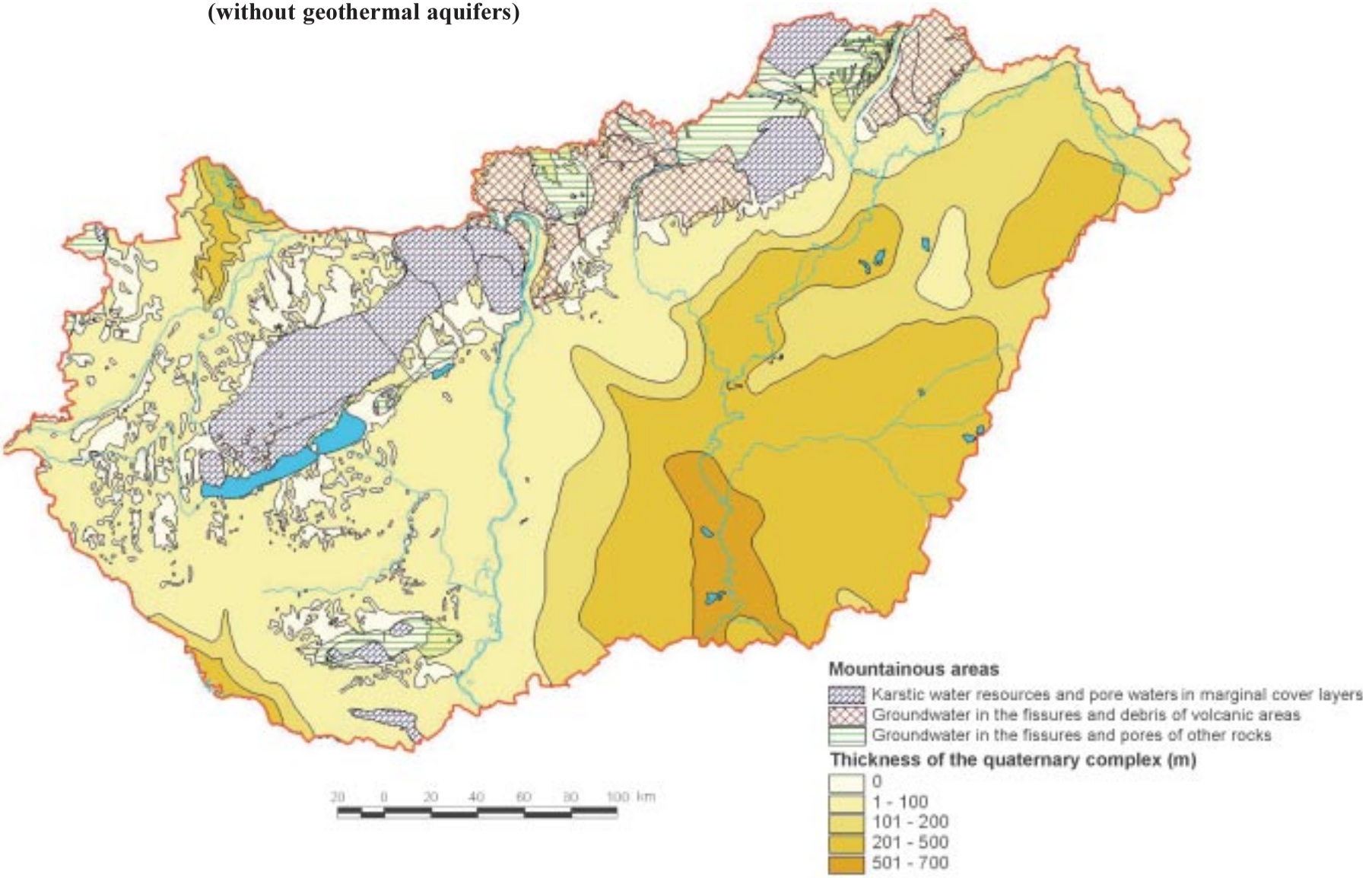


Figure 1.

Elemental units of the Water Framework Directive are water bodies, which were designated by the relevant countries on the basis of the recommendations drawn up at EU level, but in different ways.

Initial designation and delimitation of groundwater bodies was carried out accordingly in 2004-2005. In Hungary all groundwaters are parts of one or other of the water bodies. There is a wide utilisation of groundwater in Hungary, therefore aquifers with an abstraction higher than an average of 10 m^3/day can be found in the whole territory of Hungary. Primary aspect to be considered in the course of the designation was the type of the aquifer:

- *waters in the mainly porous basin sediments (down to the surface of the basement rock). Margins of the basin were designated along the outcrops of the lower-upper Pannonian border, but valleys and small basins in the mountains were not considered to be part of this group,*
- *karstic waters (mesosoic and older karstic bedrocks and Eocene karstic rocks in direct hydraulic contact with them). Younger karstic sediments in no direct contact with the aforementioned ones are belonging to the group of mountainous water bodies,*
- *waters in the various rocks of mountainous regions (all those not part of the above two categories).*

Further classification of water bodies was carried out on the basis of the temperature and the hydrodynamic-hydrochemical characteristics. Waters are divided into two groups: cold (with a temperature below 30°C) and thermal (above 30°C) waters; this enables a further classification of the above mentioned 3 categories:

- *porous or basin-type cold water bodies,*
- *porous or basin-type thermal water bodies, as well as,*
- *karstic cold water bodies, and*
- *karstic thermal water bodies.*

In the case of mountainous water bodies no thermal subgroup was defined in the course of the initial designation as thermal waters are very rare in those formations . For the delimitation of the thermal water bodies the surface of the 30°C isotherm was used. The horizontal borderlines of the porous basin-type thermal water bodies are the intersections of the isotherm surface and the lower-upper Pannonian boundary surface, because older formations are in most cases practically unsuitable for thermal water abstraction; but borders may be extended down to the basement rocks in the course of detailed designation.

Subsurface flow systems, water level and pressure distribution

- *Only a very small part of the formations introduced above, e.g. the confined geological structures settled in large depth contain waters as old as the surrounding formations. In case of marine sediments these waters are of high salt content. Also hydrocarbons have accumulated in these closed geological structures. However in the case of most subsurface reservoirs water is in permanent movement, it is being recharged from the ground surface and, moving toward the discharge area, it arrives again at the surface. The time of water exchange (traced with various isotope tests) varies on a very wide scale from a few hours to several hundred thousands of years. According to radiocarbon tests the age of waters of drinking water quality stored in the sediments in the basin-type areas is of the order of ten thousand years, while the age of thermal waters at larger depth may reach one million year. In shallow groundwaters in the coarser sediments near the surface and in the bank-filtered waters along the rivers the few days old rainwater and the water of the rivers appear as well. Water originating from the rainfall of the last 40 to 45 years can be best detected through tritium tests. Thus we can come to conclusions on the intensity of the recharge. At the average precipitation between 500 and 700 mm/year prevailing in Hungary, infiltration is the highest in the karstic regions: 150 to 200 mm/year, in the basin-type areas of sandy topsoil it is 50 to 100 mm/year while it is only 5 to 10 mm/year or less in the case of finer loess-silty-clayey topsoil. Consequently the flow velocity of groundwater is very low: it is in the order of magnitude rang-*

Regional groundwater flow-system in the Duna-Tisza region

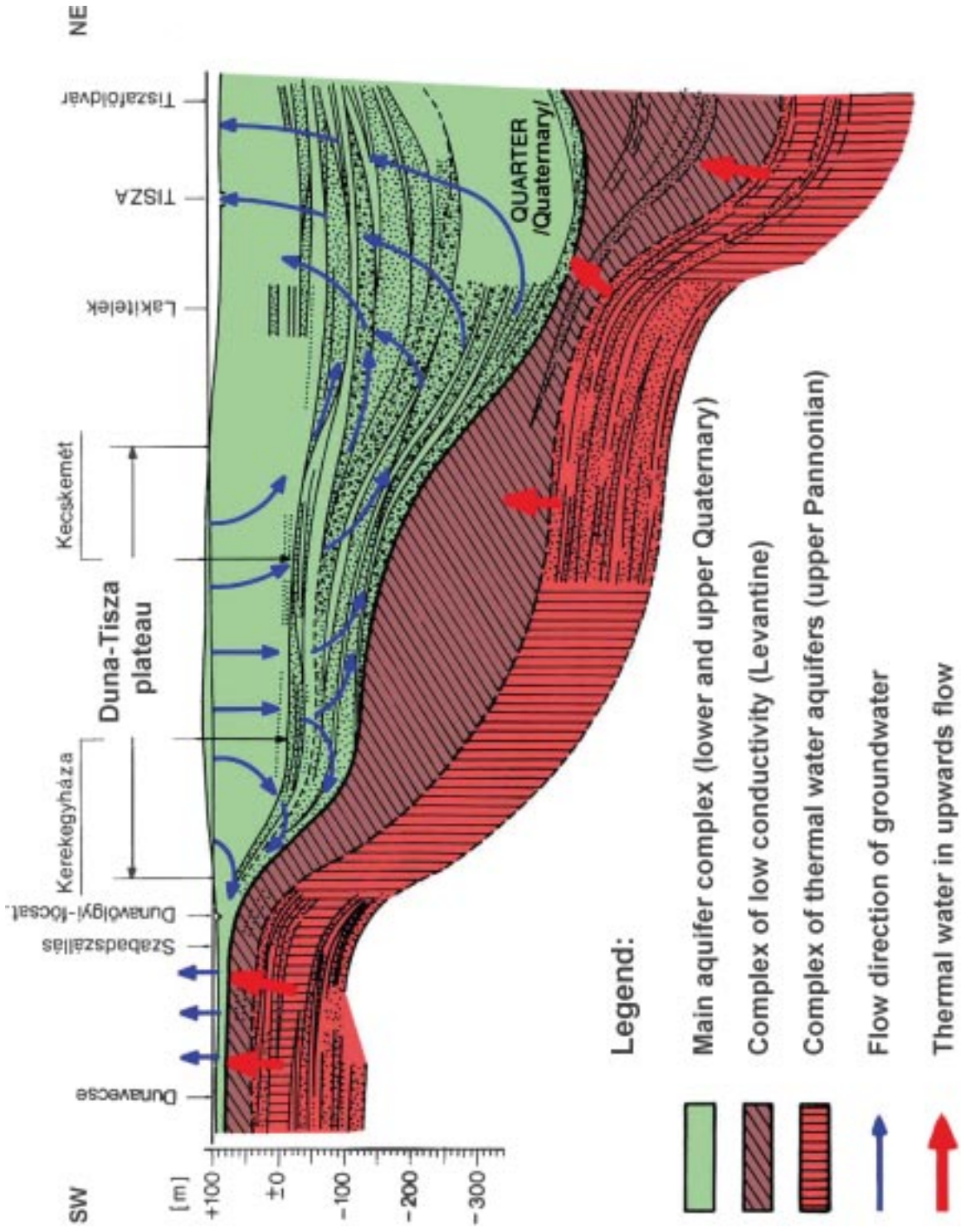


Figure 2.

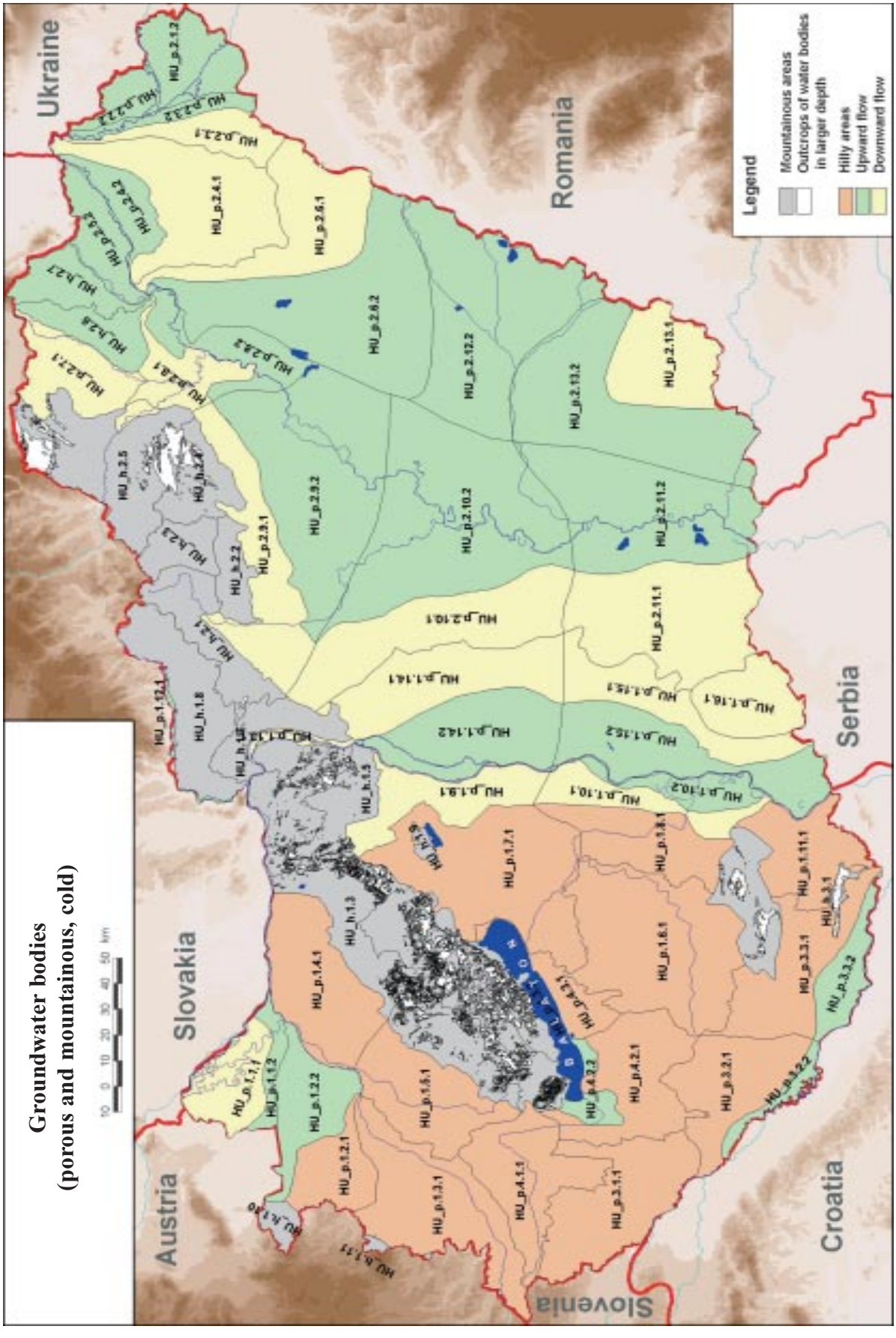

Groundwater bodies
(porous and mountainous, cold)
10 0 10 20 30 40 50 km
Legend
Mountainous areas
Outcrops of water bodies in larger depth
Hilly areas
Upward flow
Downward flow
Ukraine
Romania
Serbia
Croatia
Slovenia
Austria
Slovakia

Figure 3.

ing from 0,1 to 10,0 m/year as an average, however in coarser debris and in karstic areas it is higher; in karstic fissures the flowing water may travel several hundred meters per day. In determining the age of karstic water the use of tracers is a widespread method: this means the addition of various paints and tracers to the water disappearing in the sinkholes and observing their appearance at the springs.

Waters infiltrating in high-located areas flow towards the discharge areas in the depressions. **Subsurface groundwater flows** form regional and local flow systems (**Figure 2.**). Groundwater flowing through fissured and karstic formations mainly comes to the surface again in springs. In other mountainous areas beside the distinct points of discharge represented by springs the infiltration into the riverbeds is more significant, while in hilly regions groundwater appears mainly in the waterlogged bottoms or in small watercourses of the valleys. In plain regions discharge takes place mainly in the low located areas with a high groundwater level, where the water moving upwards evaporates or is evaporated by vegetation.

The spatial distribution of **groundwater levels** or **heads** is in accordance with the flow pattern described above: levels in the recharge areas are higher than those in the discharge areas. In the case of layered deposits in recharge areas with downward flow groundwater levels are decreasing in the wells when proceeding towards larger depths, while in discharge areas of upward flow the opposite phenomenon can be observed. In deep boreholes or wells reaching aquifers covered with layers of low or no permeability water rises highly above the tapped layer and in the depressions of discharge areas water levels in the wells may rise even above the ground surface. These so-called artesian wells enable water production without pumping driven by the pressure of water only. Wells with water levels above the ground surface ("positive" wells) were widespread in the lowlands of Hungary. High temperature, lower density and gases dissolved or separated in the form of bubbles also elevate the level of the water column in wells of higher temperature.

The groundwater balance, the levels and heads are depending on the hydro-meteorological conditions, on infiltration and recharge and on the abstraction of water. In the 80s the high rate of water abstraction coincided with dry weather, the large withdrawal exceeded the reduced recharge for a long time, which led to a significant loss in the groundwater balance: water resources stored below the surface decreased leading to the **fall of water levels**. The decrease of karstic water and deep groundwater levels does not represent an environmental problem in itself, it indicates, however, the overuse and may only be allowed on the long run if the decrease stops and a new equilibrium takes place. Environmental constraints of the decrease in the yield of springs and in shallow groundwater levels on the other hand have more serious environmental constraints: even in the case of a new equilibrium the decrease of water levels must not deteriorate the conditions of ecosystems.

The further classification of the above mentioned types of water bodies was carried out on the basis of groundwater flow systems, hydrodynamic units:

- *52 water bodies were designated by consideration of recharge, discharge areas and subsurface watersheds in case of the cold basin-type water bodies,*
- *6 on the basis of hydrodynamic units in case of thermal basin-type water bodies,*
- *13 in the case of cold karstic waters based on subsurface catchments mostly of the springs in the Transdanubian Range and on the margins of the karstic ranges in the case of other areas,*
- *15 in the case of thermal karsts according to the criteria described above,*
- *22 in the case of mountainous water bodies by consideration of surface watersheds,*

alltogether 108 water bodies were initially designated (**Figure 3., 4., 22.**) out of which more than 50% (60 water bodies) are transboundary ones.

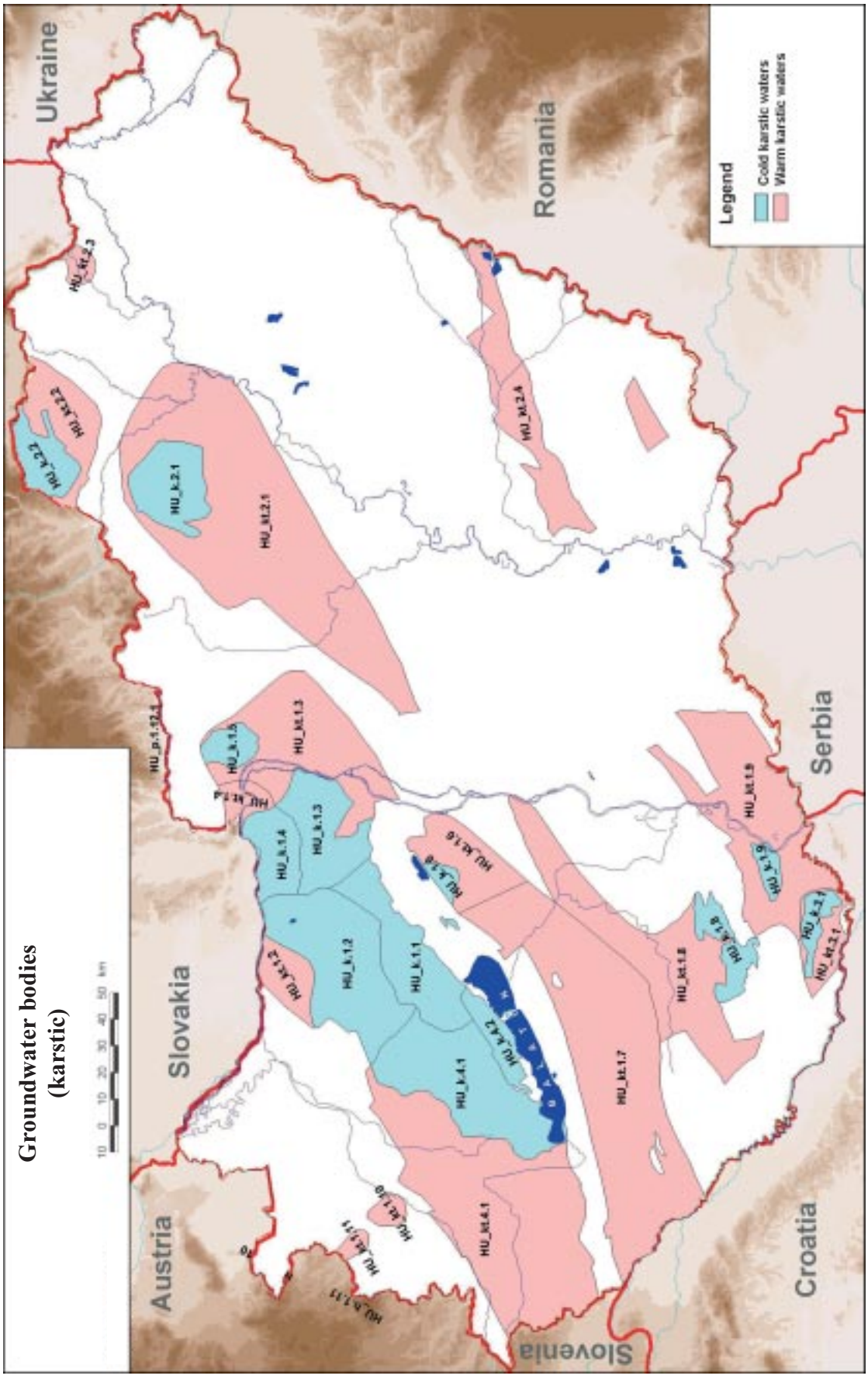

Groundwater bodies
(karstic)
Legend
Cold karstic waters
Warm karstic waters
Ukraine
Romania
Slovakia
Austria
Serbia
Croatia
Slovenia

Figure 4.

Exploration, abstraction of groundwaters and their impacts

In historical times mankind knew groundwater in the form of springs coming up to the surface or as water appearing in the shallow dug wells. Furthermore, water entering the adits of mines brought some problems about. Exploration of the water in deeper horizons with bored wells started in the 18th century and this technology has already become the most widespread form of water abstraction in Hungary. From the riverside gravel layers water is abstracted by so-called radial wells (consisting of a large-diameter shaft and a few radial, perforated, horizontal drain pipes conducting the water into the shaft), and with drains driven below the riverbed.

At present about 2,7 million m^3/d water is produced from underground in Hungary. The distribution of this volume among the various types of groundwater is as it follows:

- *near half of it comes from deep groundwater,*
- *about one third from bank-filtered water,*
- *about one sixth from karstic water, and*
- *about one twentieth of it comes from shallow groundwater (illegal withdrawals from shallow groundwater are not considered).*

About one third out of the ninety thousand drilled wells of the country is in operation as production well.

The production from underground in the 80s was by 50 per cent higher than the present rate (**Figure 5.**). The cause for the decrease in abstraction was generally the increase of the water price stimulating the users to save water. The decrease of abstraction was the largest in the case of karstic water: it has decreased to one third of the volume abstracted in the 80s because of the considerable decrease in the,once large scale, abstractions of the mining industry in the early 90s and because of closing up the relevant mines. The reduction of abstraction in the Transdanubian Range was necessary for reasons of water resources management as well: the rate of the abstracted karstic water was near twice as high as the recharge in the 80s (**Figure 6.**) and also the production from deep groundwater nearly reached the rate of allowable long-time production limits. The **overuse** resulted in the **drying out of springs** and in the large-**scale fall in karstic water level** in the karstic areas, as well as in **the decrease of deep groundwater heads and shallow groundwater levels** in the basin-type regions. The decrease in karstic and deep groundwater levels alone is not harmful, as for example in the case of karstic areas covered by soil only, karstic water under normal conditions fluctuates deeply below the surface and does not influence the water balance of the fertile soil layer because the water household of the latter does not depend on the fact that the level of karstic water is e.g. ten or twenty m below. Even though, the decrease of karstic water level may – and actually do – involve harmful and sometimes very grave consequences, but these are (as in case of other water types as well) reversible, e.g:

- *the largest **decrease in karstic water levels** could be experienced in the main aquifer of the Transdanubian Range (**Figure 7-8.**) causing the drying out of several large karstic springs. The decrease exceeded 30 meters as an average and even 100 meters at some sites. The withdrawals however have decreased considerably since the beginning of the 90s mainly because of the closing up of mines. Consequently, and because of the higher precipitation the regional rise of karstic water levels can be observed (**Figure 7-8.**). Even more important is the rise of water levels in the vicinity of the strongly endangered valuable thermal springs (Lake Héviz and the Budapest thermalkarst system). The yield of the Héviz Lake slowly increases (**Figure 9.**). From the 60s several springs yielding a large volume of lukewarm and warm water stopped in the Transdanubian Range; their operation has started again at the late 90s or may be expected in the near future (**Figure 10.**).*
- *since the 70s a permanent fall of the **heads of deep groundwater** could be observed as a result of water abstraction. In the layers*

Groundwater abstraction in the years 1981 to 2003

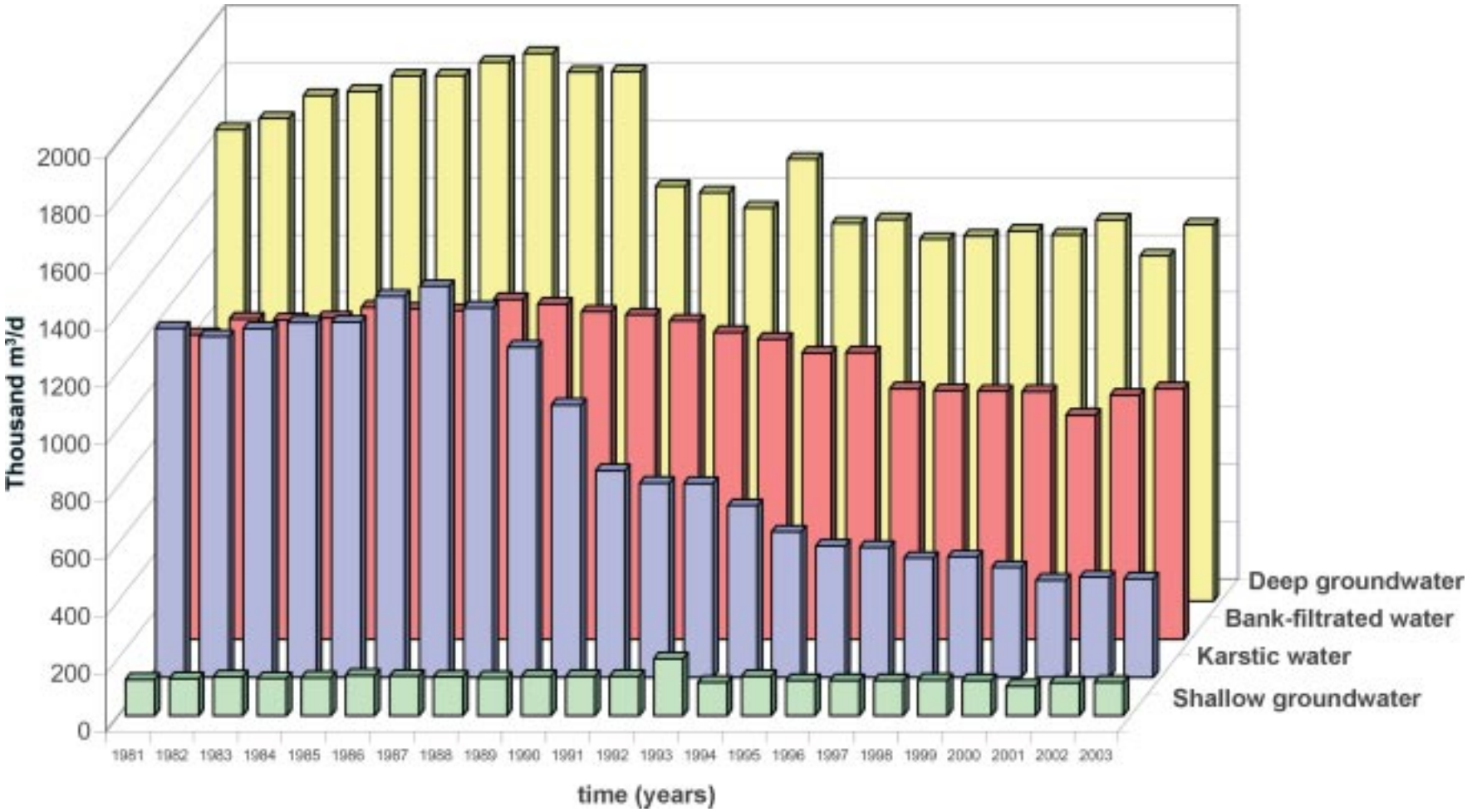


Figure 5.

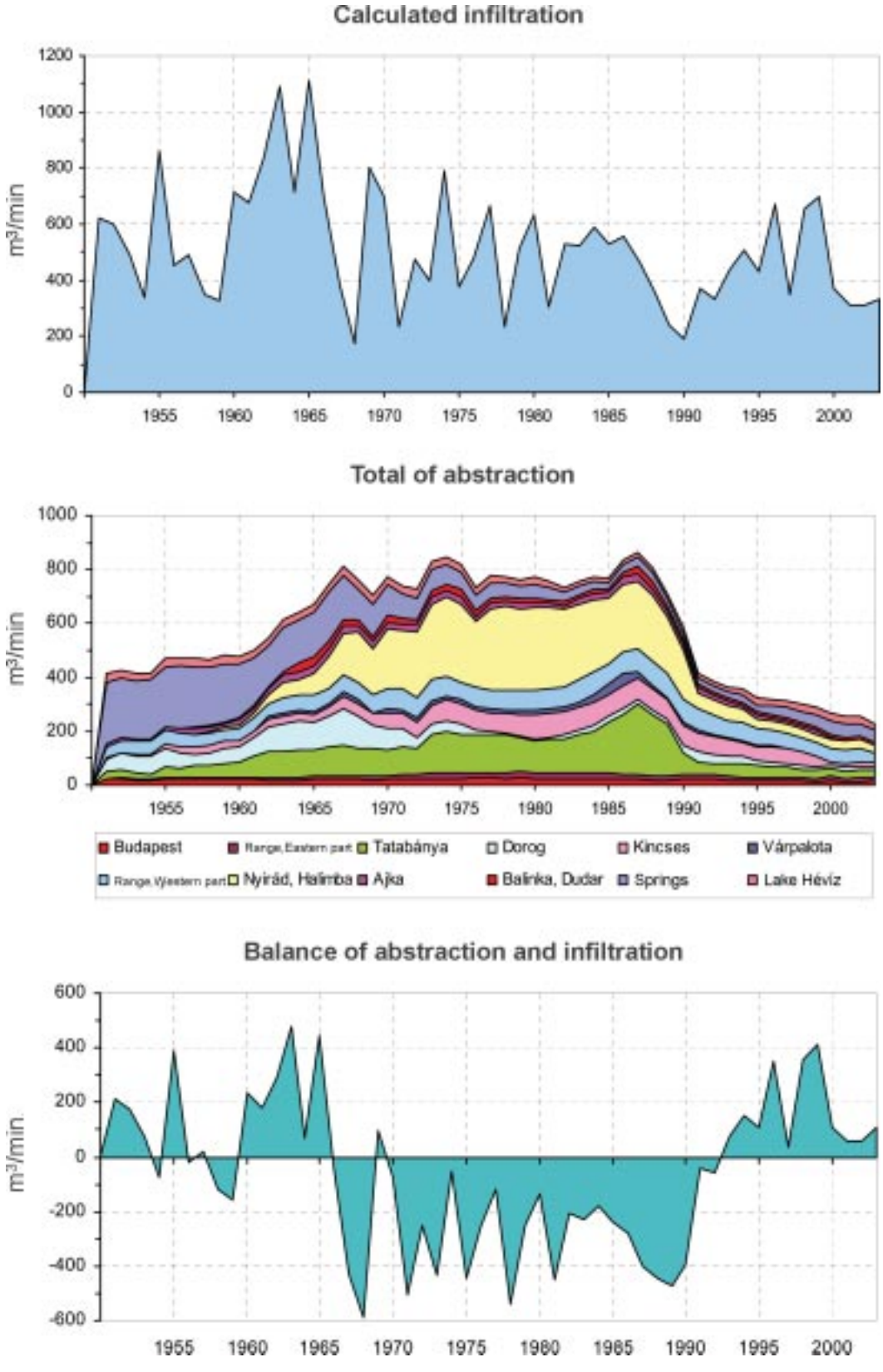


Figure 6.
Variations in the water-household of the main karstic aquifer of the Transdanubian Range (DKH)

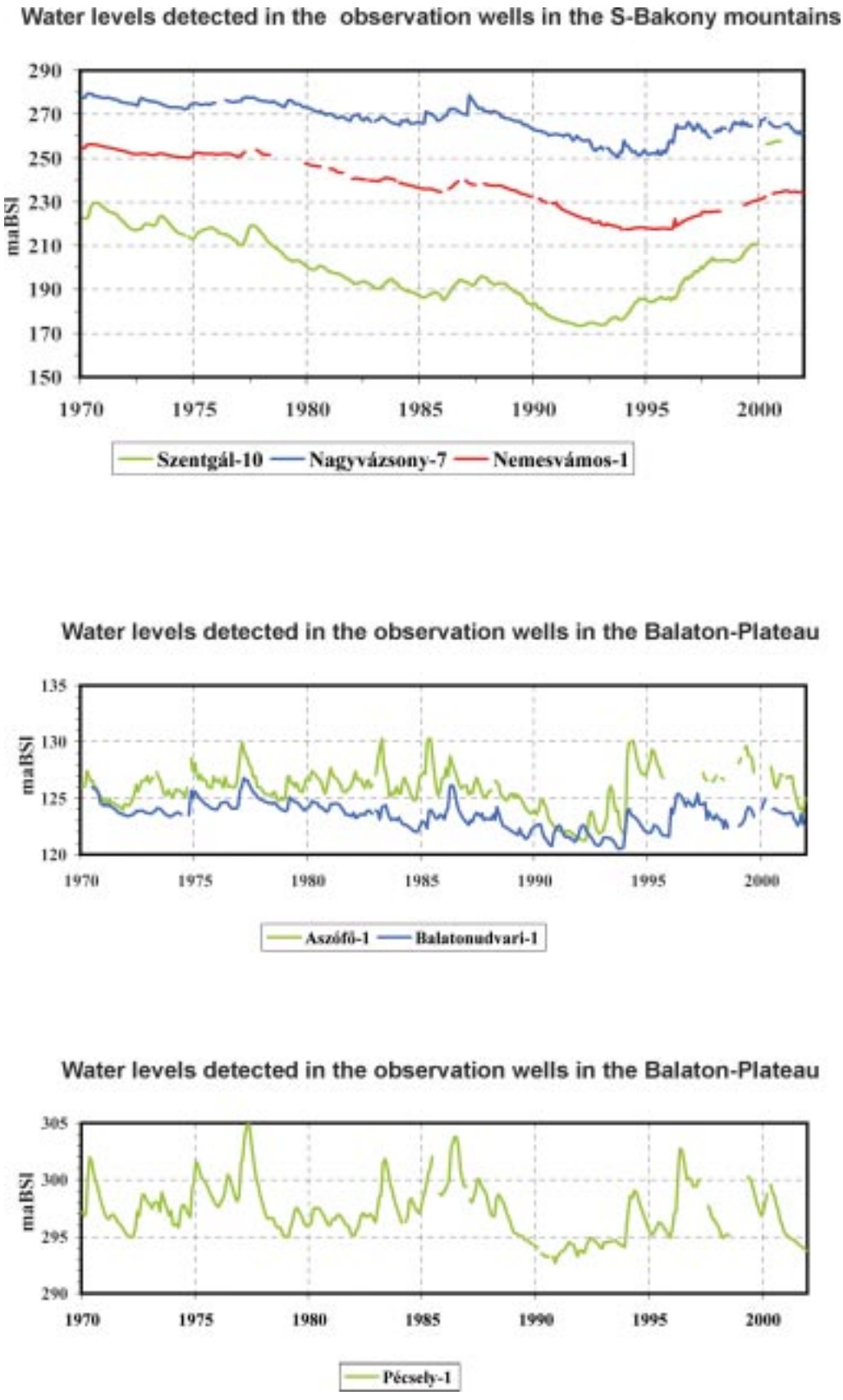


Figure 7.
Variations in karstic water levels in the Transdanubian Range
(series are discontinuous due to the lack of data)

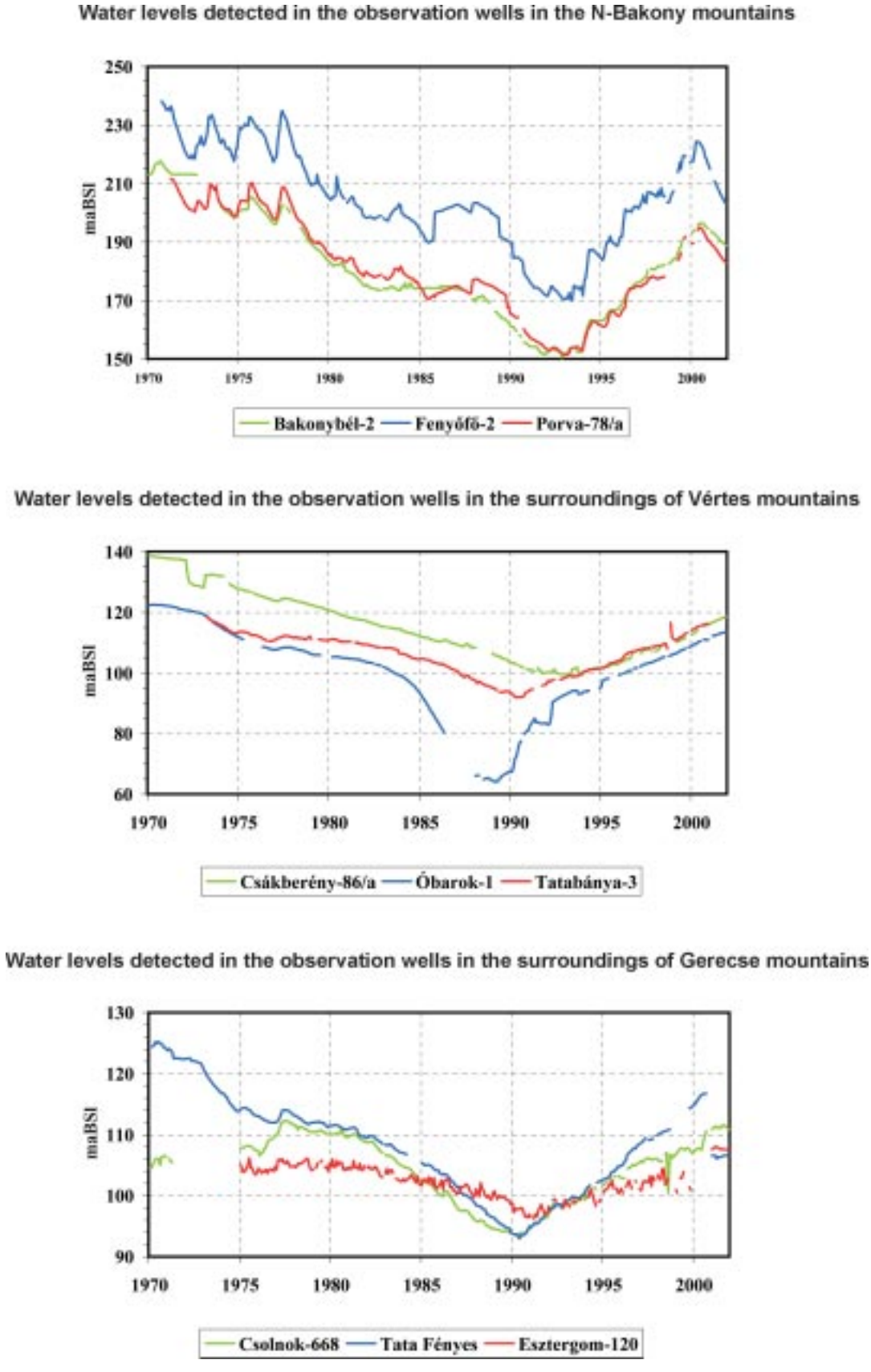


Figure 8.
Variations in karstic water levels in the Transdanubian Range
(series are discontinuous due to the lack of data)

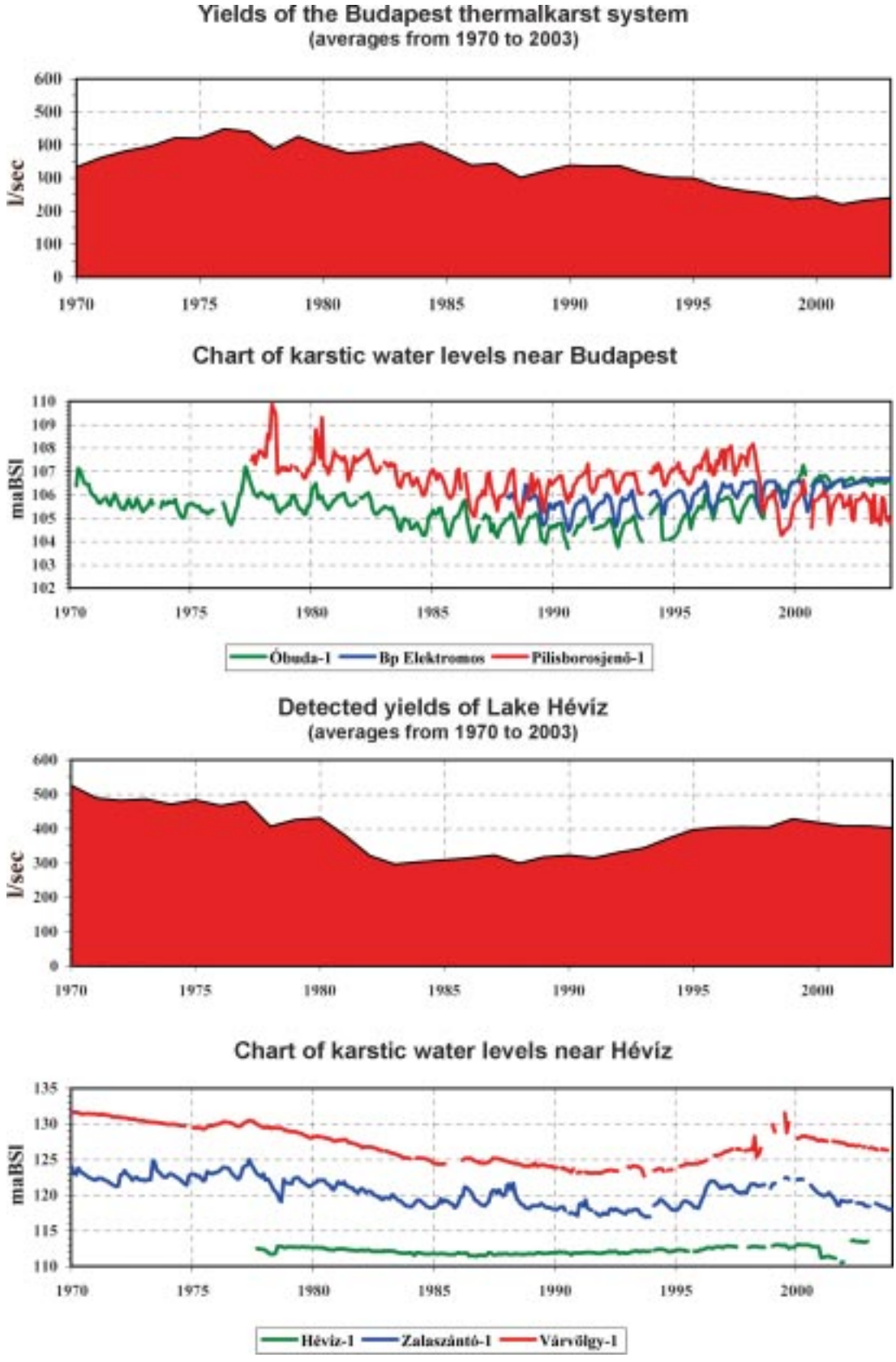


Figure 9.
Yield regime of Lake Hévíz, of the Budapest thermalkarst-system and the observed water levels in their environs 1951–1999
(series are discontinuous due to the lack of data)

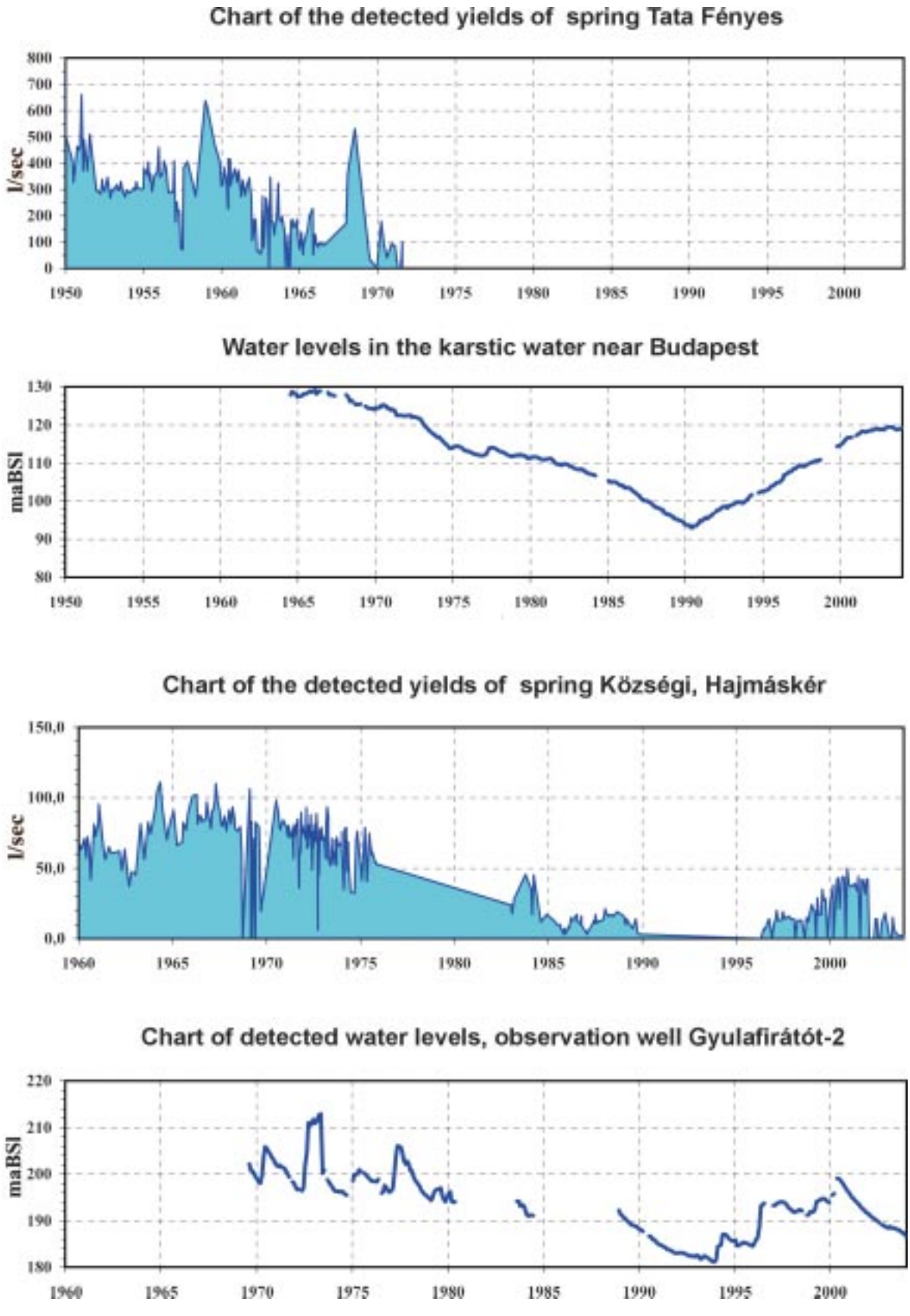


Figure 10.
Variations in the yields of karst springs in the Transdanubian Range
(series are discontinuous due to the lack of data)

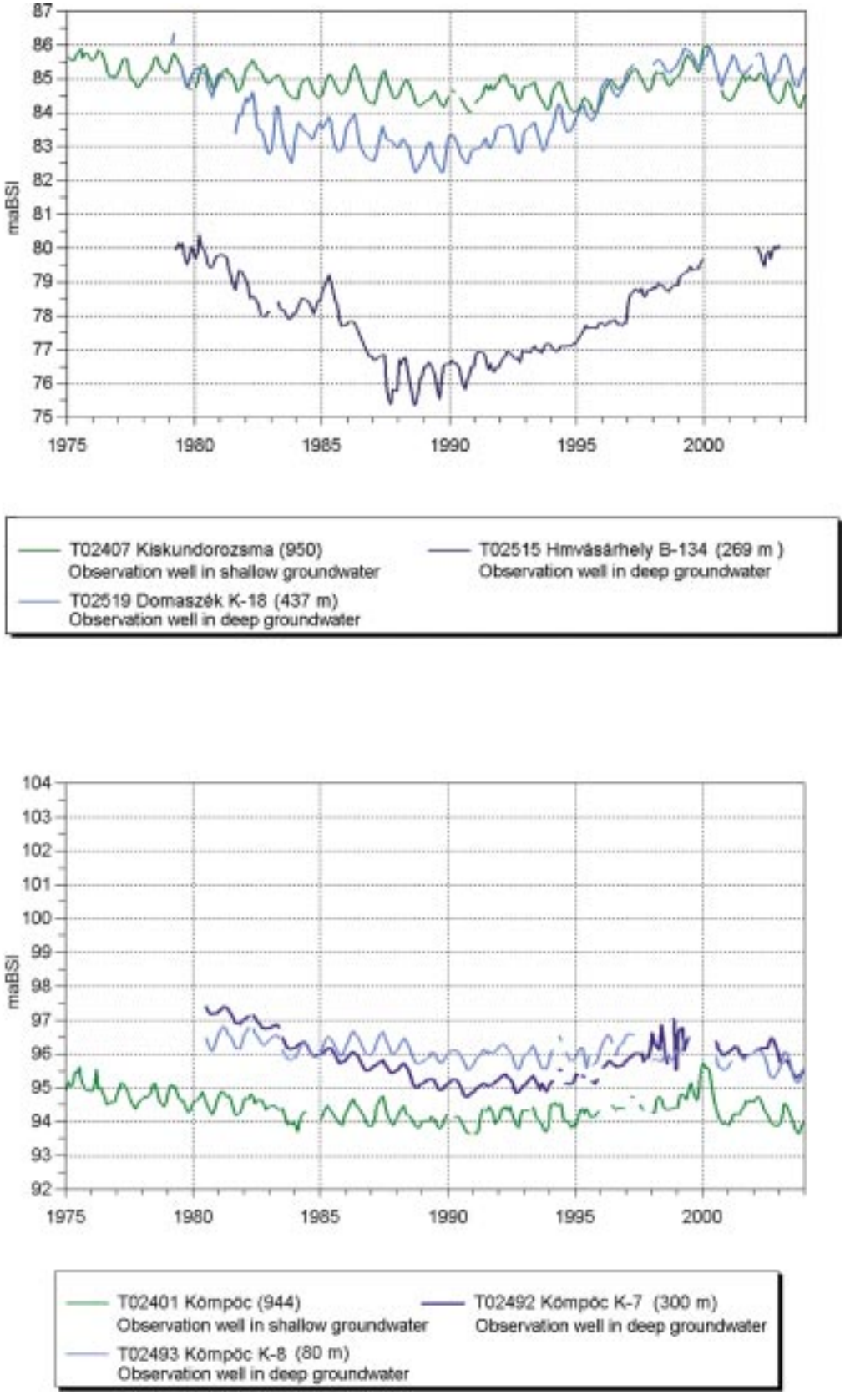


Figure 11.
Levels of shallow- and deep groundwater in the southern part of the Great Hungarian Plain

(series are discontinuous due to the lack of data)

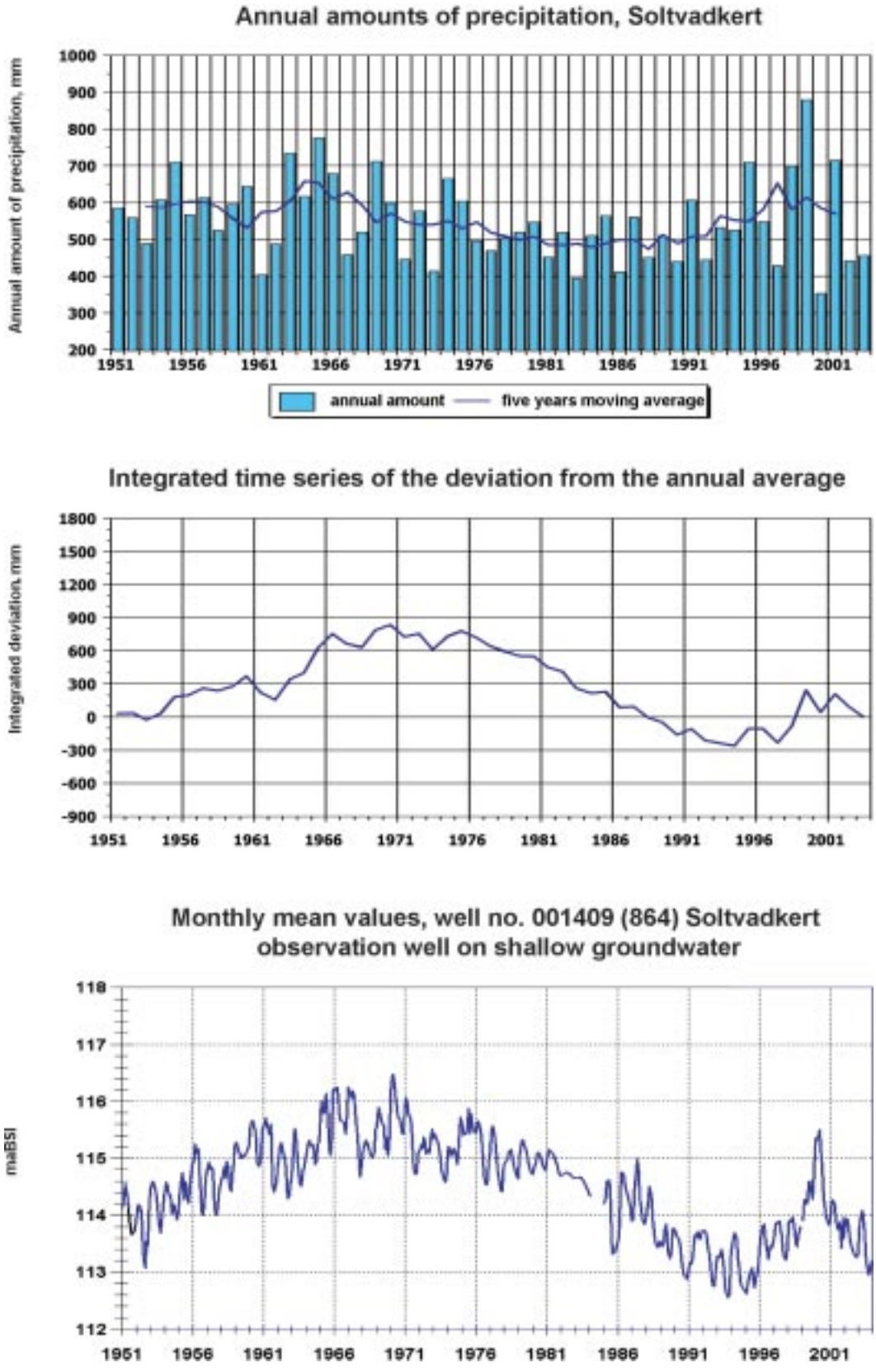


Figure 12.
Comparison of the yearly total precipitation and the integrated values of their deviation from the average to the level-changes of shallow groundwater
(series are discontinuous due to the lack of data)

*yielding water of drinking water quality a decrease in the levels/heads of 5 to 10 m was measured. In the vicinity of major water supply works and in the deeper thermal water reservoirs the decrease reached several 10 metres (**Figure 11.**). The results of the decrease of water abstraction in the early 90s became visible in the level variations: the decrease has been moderated and an increase was detectable at some places.*

– *the variations of **shallow groundwater level** depend mainly on precipitation: loss or surplus of infiltration accumulates for years* (***Figure 12.***). *The change in flow conditions caused by the abstraction of deep groundwater already mentioned above influenced shallow groundwater balance as well due to the (limited) hydraulic connection between shallow and deep groundwater. The downward movement of water increased in the recharge areas while in the discharge areas the upward flow was decreased or stopped. The drop of groundwater levels could be detected on a nationwide scale in the 80s; at some places it was especially large. In some areas of the Duna (Danube)-Tisza Plateau the drop of shallow groundwater-level exceeded the value of 3 m* (***Figure 13.***). *The reason was mainly the lack of precipitation in the two decades before the last few years, however the impact of the abstraction from deep groundwater could be detected as well. The rainy weather in the second half of the 90s moderated the drop of groundwater levels here; moreover at some places a rise of levels can be detected. According to the forecasts significant rise of the groundwater levels can be expected in the next decade if the rainy weather continues for a long time.*

In the Szigetköz area no groundwater abstraction, but the diversion of the Danube was the reason of changes in groundwater level: a 1 to 3 meters drop of shallow groundwater level was detected in the 1 to 2 km wide zone along the shoreline of the parent branch of the Danube between Dunakiliti and Ásványráró. This, as well as the absence of an increase of shallow groundwater levels concomitant with flood waves had harmful consequences on the terrestrial ecosystem, especially in the flood plains, where in addition to the non-occurrence of floods there has been a significant decrease in the extent of humidification of the some meters thick, fine grained covering layer by shallow groundwater. Although the reservoir at Dunacsúny and to a smaller extent water supplementations in the flood plains have increased the shallow groundwater levels the damage has still not been ceased (**Figure 14.**).

Quantitative risks stated in the EU Water Framework Directive were analysed by the comparison of the monitoring and water abstraction data with the available water resources. Quantitative risk (i. e. the risk of failing to meet good quantitative status by 2015 as stated in the Water Framework Directive) indicated by the trend of increasing water levels and the changes in groundwater flow is detectable in the Szigetköz, the southern part of Nyírség and the Hajdúság, as well as in the marginal regions of the North-Hungarian Mountain Range. Further 18 water bodies were classified as "possibly at risk" making further investigations necessary: cold basin-type water bodies in the Great Hungarian Plain (GHP) (except for the N-NE part), the thermal basin-type water body in the SW part of GHP and some cold karstic water bodies – the Balaton Highlands, watersheds of the Tata and Fényes springs in the Transdanubian Range and the karstic water body in the Bükk Mountains. Quantitative and chemical risks are shown on **Figures 20. to 22**.

The basis of the quantitative monitoring of groundwater consists of the Shallow Groundwater Level Monitoring Network currently in operation (1596 wells), the Deep Groundwater Level Monitoring Basic Network in basin-type areas (378 wells), the Karst-Water Level Monitoring Basic Network (245 wells), the Basic Monitoring Network of Springs (51 springs) and the Groundwater Level Monitoring Network of MÁFI (150 wells). In order to meet the requirements of the Water Framework Directive the network system needs further development, especially along some small watercourses, in areas of particular

Deviation of the average level of shallow groundwater in the year 2003 from the average of the years 1956 to 1960

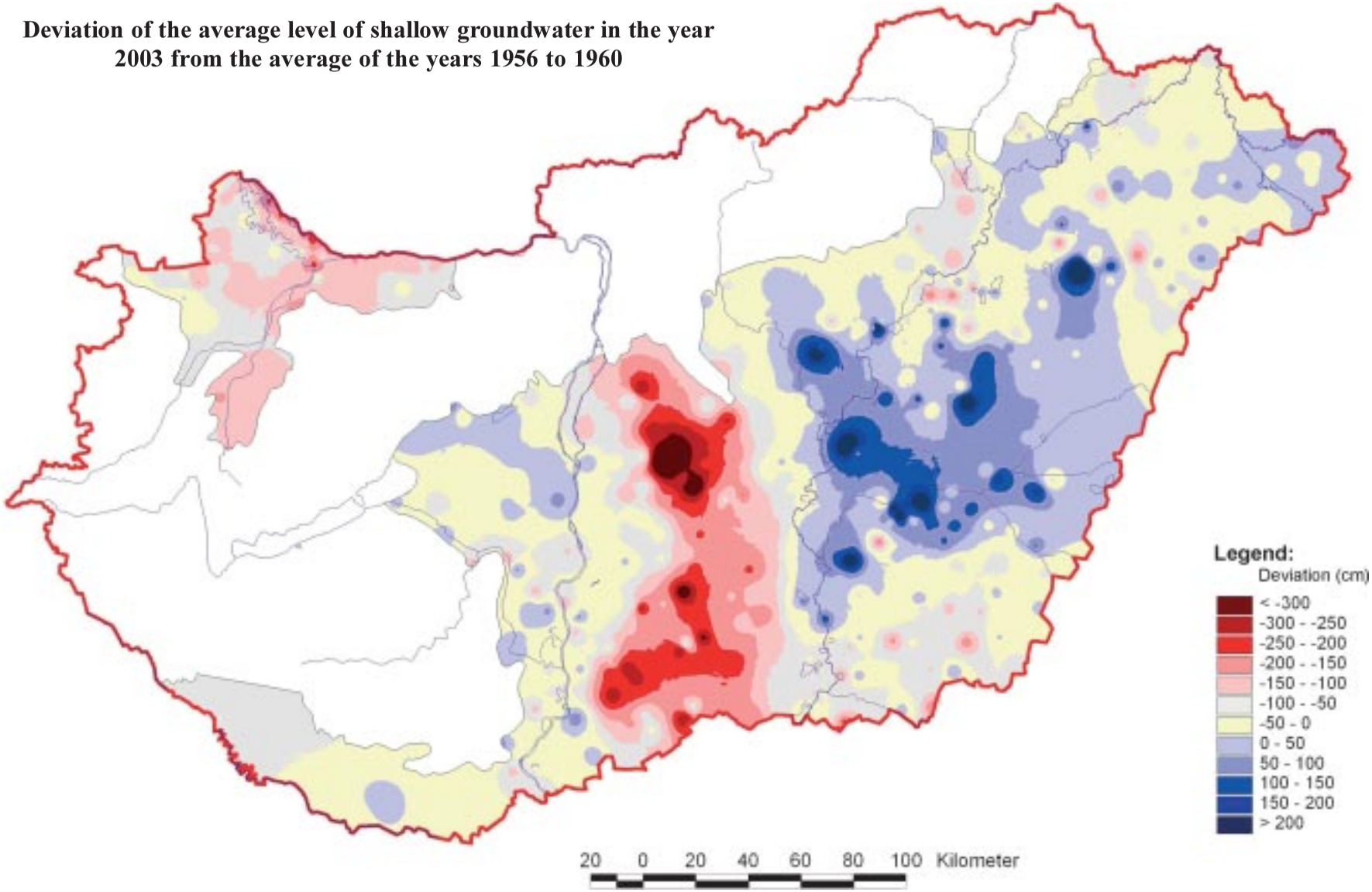


Figure 13.

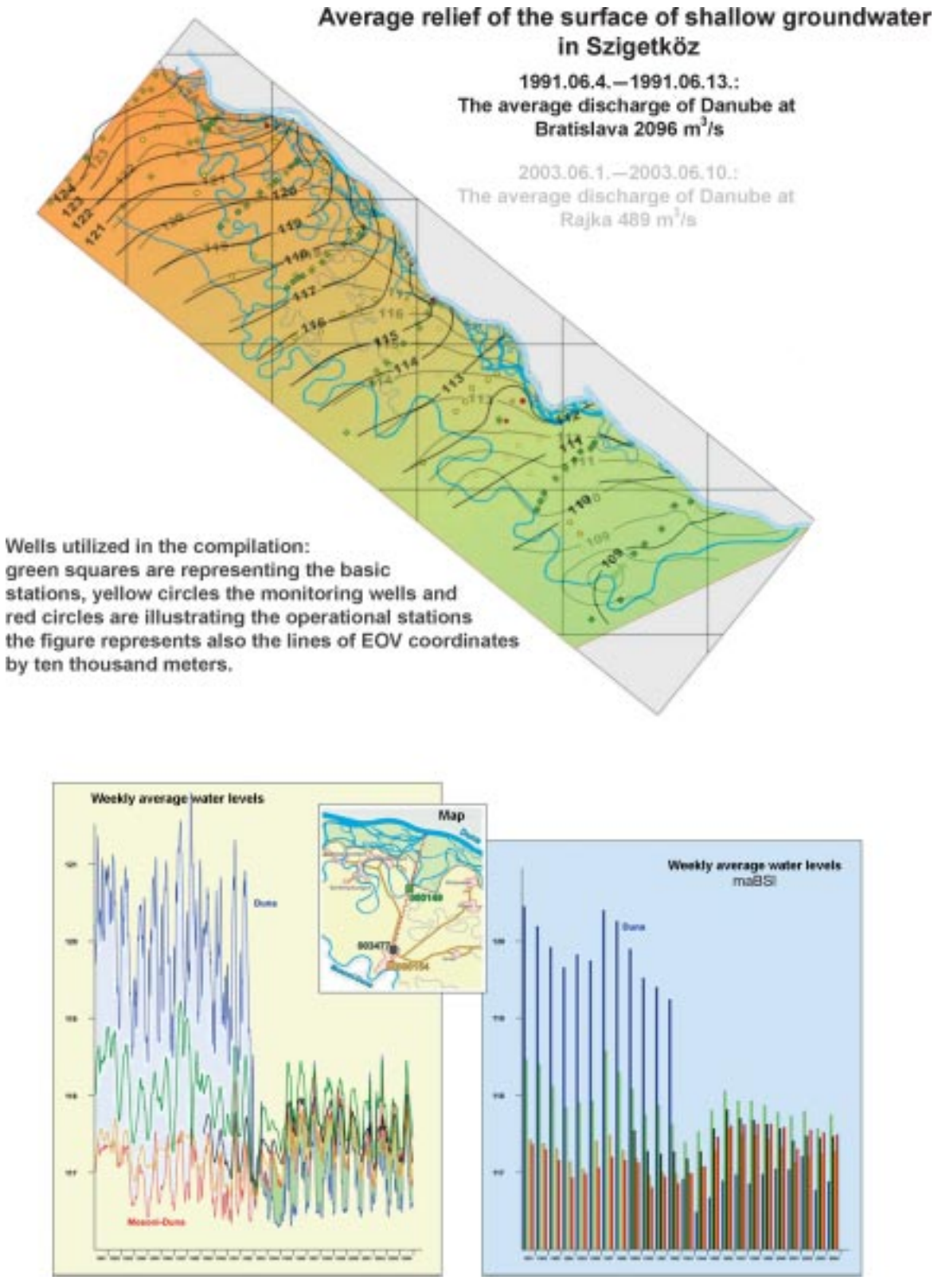


Figure 14.
Variations in the shallow groundwater level in the Szigetköz

interest because of the connection of terrestrial ecosystems and groundwater and in the deep aquifers by using abstraction wells out of operation. Necessary monitoring points will be selected from the extended networks and the local networks of drinking water supplies. After 2006 this new network has to be in operation. The aim of the operation of the monitoring network is to provide data for the determination and supervision of the abstraction limit value and the available groundwater resources, as well as the observation of the trends of groundwater level and head changes. To the evaluation of the results however series of hydro-meteorological and abstraction data, acquired in the course of construction data of the new wells and the water levels of the operating wells are necessary.

Temperature of groundwaters, the geothermal situation

The geothermal gradient (indicating the increment of temperature (°C) per depth-unit) is 5°C /100 m being about one and a half times higher than the worldwide average. This is partly because in the Pannonian basin, where Hungary is situated the earth-crust is thinner (only 24 to 26 km) than the worldwide average of 30 to 35 km. Moreover the basin is filled up with well insulating clayey and sandy sediments. The measured values of thermal flux (i.e. the heat-output coming from large depths) are high (90 mW/m2 as an average) in comparison with the average of 60 mW/m2 in the European continent. The mean temperature is about 10°C on the surface of the country.

In accordance with the geothermal gradient mentioned above the temperature of the rocks and that of the water contained by them is 60°C at the depth of 1 km and 110°C at the depth of 2 km. In the South-Transdanubian Region and in the Great Hungarian Plain the geothermal gradient is higher than the countrywide average while it is lower in the Kisalföld region and in the hilly areas. Water moving upward in the thermal wells cools down along the casing therefore temperature rarely exceeds the 100°C on the surface. Steam occurrences of large depth are known only in a few, not sufficiently explored sites.

In Hungary the wells and springs yielding water warmer than 30°C are considered thermal wells/thermal springs. Thermal water can be accessible in about three quarter of the country's area (**Figure 16.**). Some more detailed information can be found in the Guide published by the Ministry for Environment the year 2001: "Thermal Water Resources in Hungary, their Utilisation and Protection".

The intensive drop of heads in the deep thermal water reservoirs of the basin-type regions caused by the production of thermal water (**Figure 15.**) stopped or has been moderated in most of the sites since the late 80s. Although information on the production rates is incomplete, the moderation of the drop may be attributed to the decrease of production even having only unsatisfactory data.

900 of the 1400 thermal wells in the country are in operation as production wells, their total abstraction is near 0,2 million m^3/d.

About 30 per cent of the wells producing thermal water are used for balneological purpose, more than one quarter is operated for drinking water supply and almost half of them are used for the production of geothermal energy. Abstractions for the purpose of geothermal energy utilisation alone will not be permissible without re-injection in the future: the cooled water will have to be re-injected into the geothermal aquifer.

The designation of thermal water bodies was discussed in the chapter Groundwater types.

Quality of groundwater

The quality of groundwater is determined mainly by the rock in which it is stored or where it is in movement. The original quality of water is highly influenced by the flow, by the travel time of water below the surface and temperature has a certain influence as well.

Water levels in the observation wells of the Geological Institute of Hungary (series are discontinuous due to the lack of data)

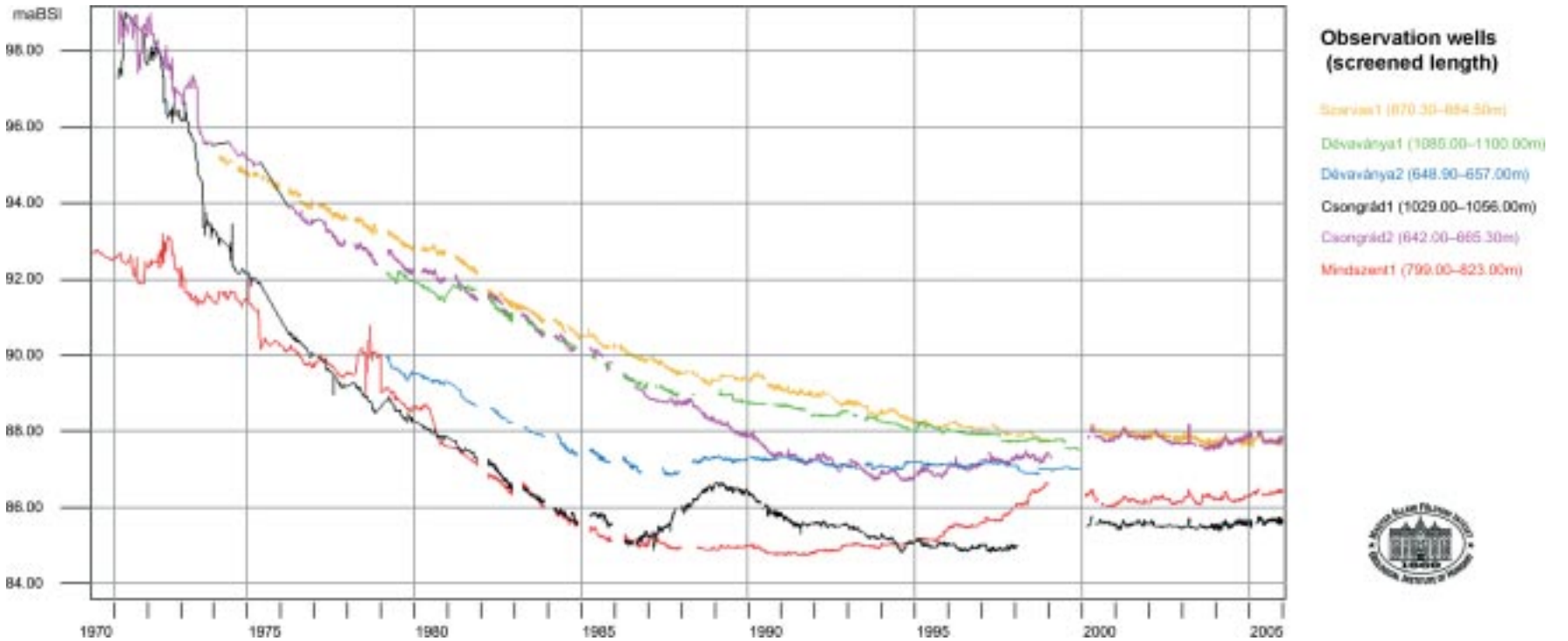


Figure 15.

Thermal water wells in Hungary

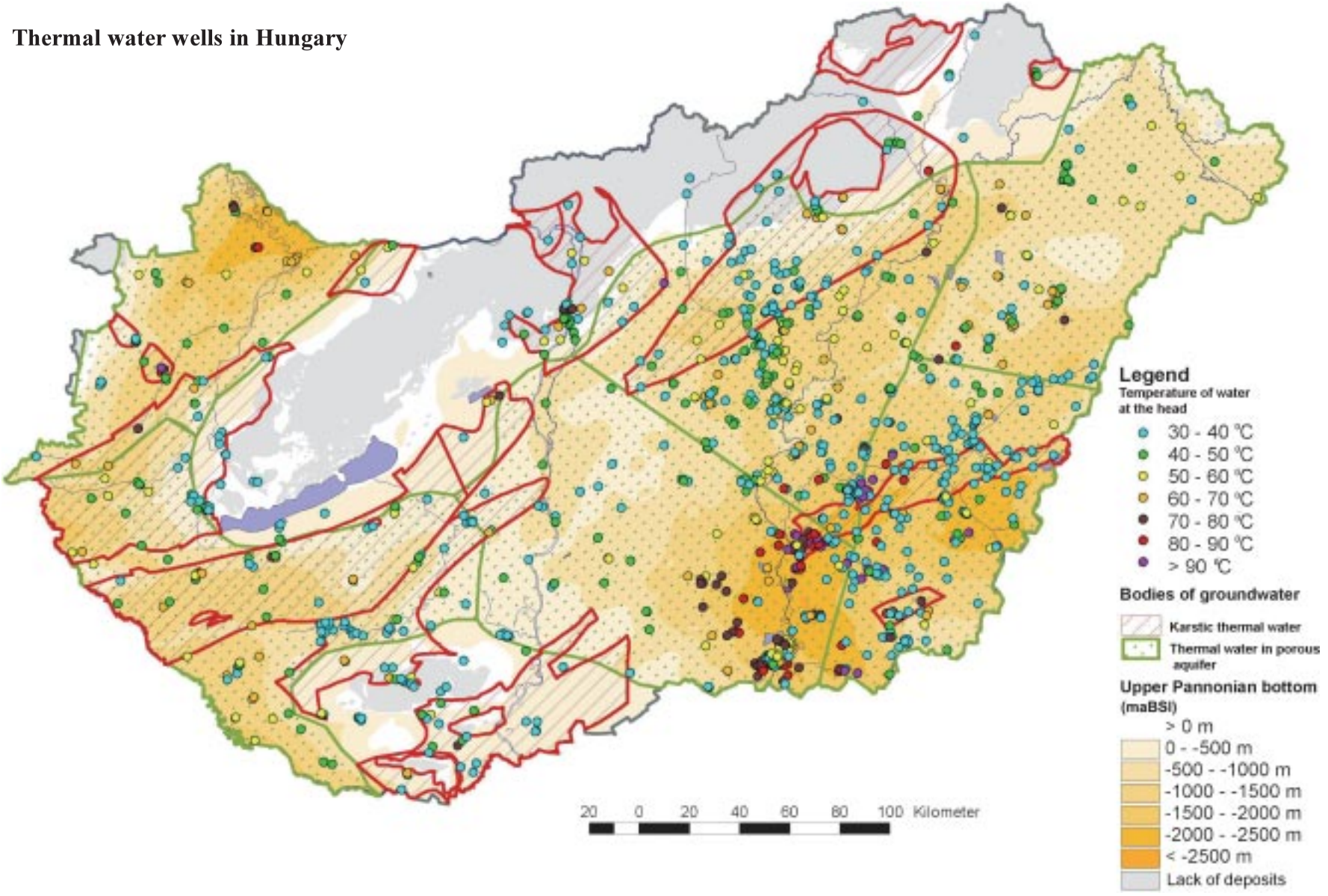


Figure 16.

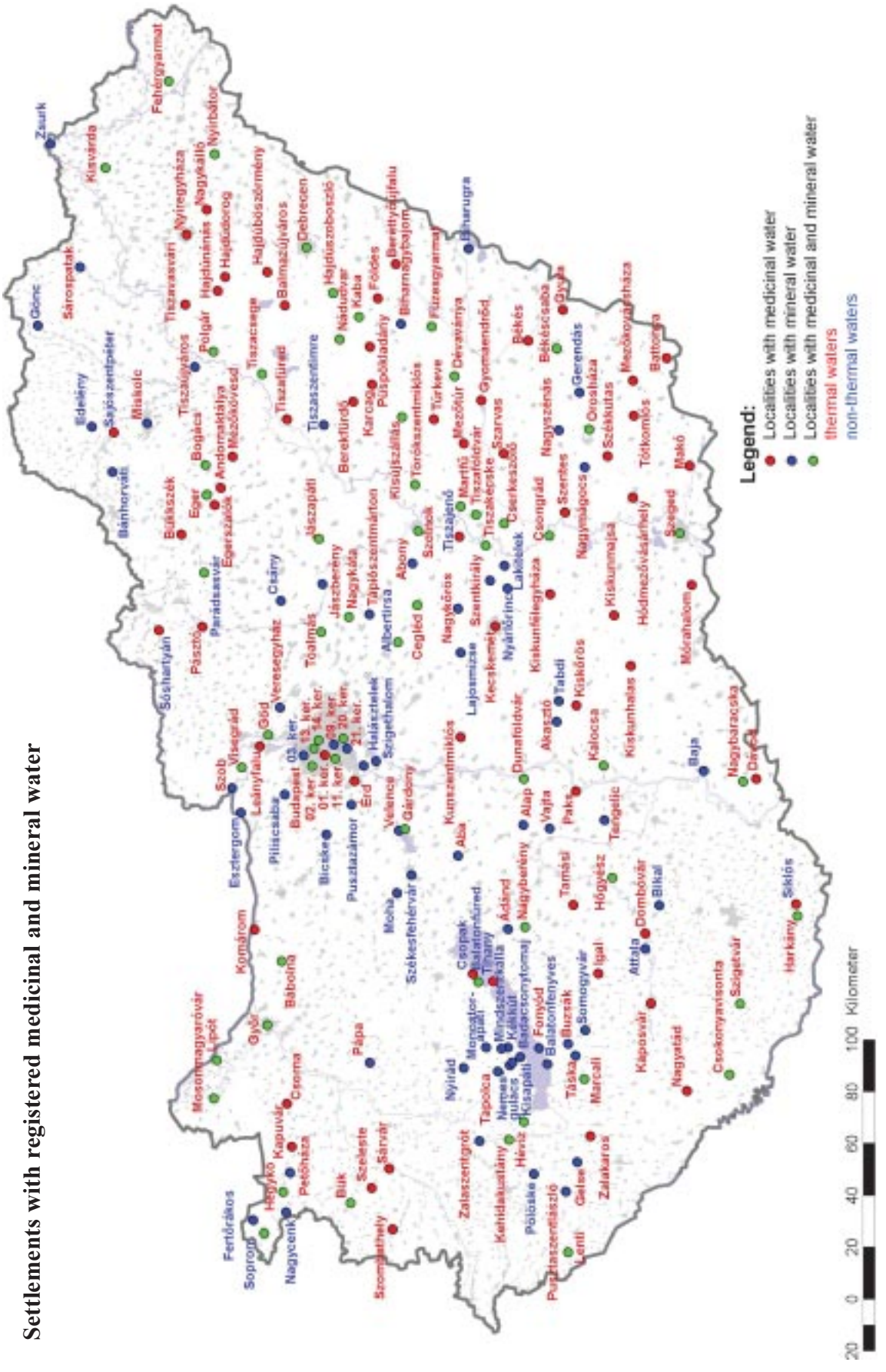

Settlements with registered medicinal and mineral water
Legend:
Localities with medicinal water
Localities with mineral water
Localities with medicinal and mineral water
thermal waters
non-thermal waters
20 0 20 40 60 80 100 Kilometer

Figure 17.

Pollutions of human origin change the original water quality as well, especially near the surface.

In the 500 m thick upper zone of the gravel- and sandy aquifers used for drinking water supply in the **basin-type areas** the dissolved solid content of waters is less than 1g/l. In the recharge areas the calcium-hydrogen carbonate (hard) type is characteristic turning into the alkali-hydrogen carbonate (soft) type in direction of the flow along the flow pass. In the central discharge areas of the basin (e.g. in the middle of the Great Hungarian Plain) the water flowing upward is so soft that it can hardly be used as drinking water. At some places iron, manganese and ammonium can be detected as a product of anaerobic processes. In some parts of deep groundwater the natural arsenic content causes problems in the utilisation as drinking water and the methane content brings about the danger of explosion. Consequently the natural quality of deep groundwater is not always in compliance with the requirements of drinking water supply. Even the deep groundwater without contamination of human origin need some treatment and their composition causes problems in the course of water treatment and distribution: a secondary pollution is caused by the high ammonium and organic content.

Waters in the geothermal reservoirs usually below 500 m are of alkali-hydrogen carbonate character. The total dissolved salt content is generally 1 to 3 g/l, however it can reach the value of 10 g/l. Waters of higher salt content occur in the deeper, confined zones of the reservoirs. In such places waters are characterised by higher chloride content and their composition is similar to that of seawater. The gas content of thermal waters is very high at many places: 1 m^3 water transports several cubic meters of gas up to the surface from such aquifers. Beside methane carbon dioxide may be significant, the separation of which results in the deposition of dissolved lime in the pipes, causing problems in the operation. In the water of certain wells oil and phenol occurs as well.

Karstic waters are basically of calcium-magnesium-hydrocarbonate character because of the dissolution of carbonate rocks. The process of dissolution starts immediately after infiltration: water takes carbon dioxide from the soil and dissolves the carbonate rocks. The dissolved solid content of cold karstic waters is low, they are highly suitable for drinking water supply, however they can be polluted more easily from the surface.

The dissolved solid content of lukewarm and warm karstic waters is low in the zones of more intensive flow: their total dissolved salt content does not reach the value of 1 g/l (e.g. Héviz). At larger depth the carbon dioxide originating from the metamorphosis of sunken rocks, furthermore the mixing of cold and warm waters makes these waters able for dissolution again. This is how the caves of thermal origin have come into being in the vicinity of the thermal springs in operation (e.g. in Budapest). Because of the contact with clayey formations present in carbonate rocks the chemical character of water may be of alkali hydrogen-carbonate nature, a considerable amount of sulphate can originate from the decomposition of pyrite and sulphur can occur in the form of sulphide as well. In confined thermalkarstic reservoirs located at larger depth the NaCl concentration may increase: in some cases it can even reach the concentration of several 10 g/l corresponding to that of seawater (e.g. Rábasömjén). Out of gases carbon dioxide is present in the largest quantity in thermal karstic water, which makes these waters aggressive.

The greatest part of groundwater in Hungary is suitable for **drinking water supply**; in the case of deep groundwater the application of the proper water treatment technology is necessary, other types need disinfection only. The public health limit values by components had been provided earlier by a national standard (Standard MSz 450-1-1989).

At present the Government Decree No. 201/2001. (X. 25.) Korm. on the quality

requirements of drinking water and on the order of supervision specifies the new limit values complying with the requirements of the European Union. These regulations are referring to tap waters.

In **Annex 3** the above-mentioned limit values are listed together with the groundwater pollution limit values set out in the Joint Decree No. 10/2000. (VI. 2.) KöM-EÜM-FVM-KHVM on limit values established for the protection of groundwater and the geological medium. In determining the latter the relevant regulations and the preservation of drinking water quality were the definitive aspects.

The qualification of waters as registered medicinal water is possible only on the basis of medical tests verifying their curative effects, i.e. the chemical composition of waters in itself is not enough, each abstraction of water must be qualified separately. (**Ministerial Decree No. 74/1999. (XII. 25.) EüM** on natural curative factors).

The meaning of the expression "natural mineral waters" was changed significantly by the promulgation of the **Joint Decree 65/2004. (IV. 24.) FVM-EszCsM-GKM** on the rules of bottling and marketing of natural mineral water, spring water, drinking water, drinking waters with enriched mineral content and flavoured water in accordance with the European Council Directive 80/777/EEC. The joint decree mentioned above does not specify limit values as minimum requirements for the total mineral content or for the concentration of biologically active substances.

*Waters of higher temperature contain more dissolved substances in general, therefore a great portion of the registered medicinal waters in Hungary are thermal waters (**Figure 17.**). The curative effect of thermal waters comes from their high dissolved solid content (calcium-magnesium-, sodium-potassium-hydrogen carbonate, sulphate, chloride), however the biologically active substances of lower concentration play a role as well (e.g. sulphur, carbonic acid, radioactivity). One type of cold medicinal waters is represented by the post volcanic occurrences of sour waters with high carbonic acid and iron content (Parád, Balatonfüred, etc.); bitter waters found in clays belong to another group (Budapest, Nagyigmánd, etc.).*

Groundwater pollution, risk of pollution

It comes from the foregoing review of water bearing and/or highly permeable **geological formations** that shallow aquifers with good recharge and of high permeability are the most sensitive ones against pollutions from the surface. The pressure conditions of aquifers have a certain role as well: in the areas of infiltration and recharge the contamination can move downwards with water; this can occur in the discharge areas of upward flow only locally. Pressure however can change because of withdrawals and so contamination can move downwards in areas where the flow had an upward direction before. In karstic areas, through the outcrops of carbonate rocks contamination can move without any hindrance down to the level of karstic water and even further because of the intense mixing of water. In such areas both the lateral movement and the spread of contamination are fast. In basin areas it is basically the shallow formations that define the spreading of contamination: in gravel layers spreading – similarly to the karsts – is very fast, it is slower in sandy layers and very low in the silty, clayey layers. In the latter cases the adhesion of contamination on the surface of the fine grains may have an additional role in the slow spread of contamination as well.

A wide scale of **pollution sources** is endangering groundwater, however it must be emphasised that a certain part of the quality problems is connected to the natural properties of waters (e.g. the high iron, manganese, ammonium concentration, and in some cases the arsenic content exceeding limit values in deep groundwater). High nitrate concentration however hints to pollution from the surface. **Figures 18. and 19.** show the distribution of ammonium and nitrate in the various water-types correlated to the public health limit values in 2004 (based on the data provided by the Basic Groundwater Quality Net-

work and the Environmental Groundwater Quality Network).

Nitrification is the most frequent contamination process, caused dominantly by municipalities without sewerage, and the use of manure and fertilizers in agriculture. Earlier the public health limit value was 40 mg/l according to the Hungarian drinking water standard, at present it is 50 mg/l. **Figure 19.** shows that the ratio of nitrate concentrations above limit value is significant only in the case of the samples taken from shallow groundwater, it is 5 to 10 per cent in karstic water, confined shallow groundwater and bank-filtered water, while it is negligible in waters located deeper than 50 m.

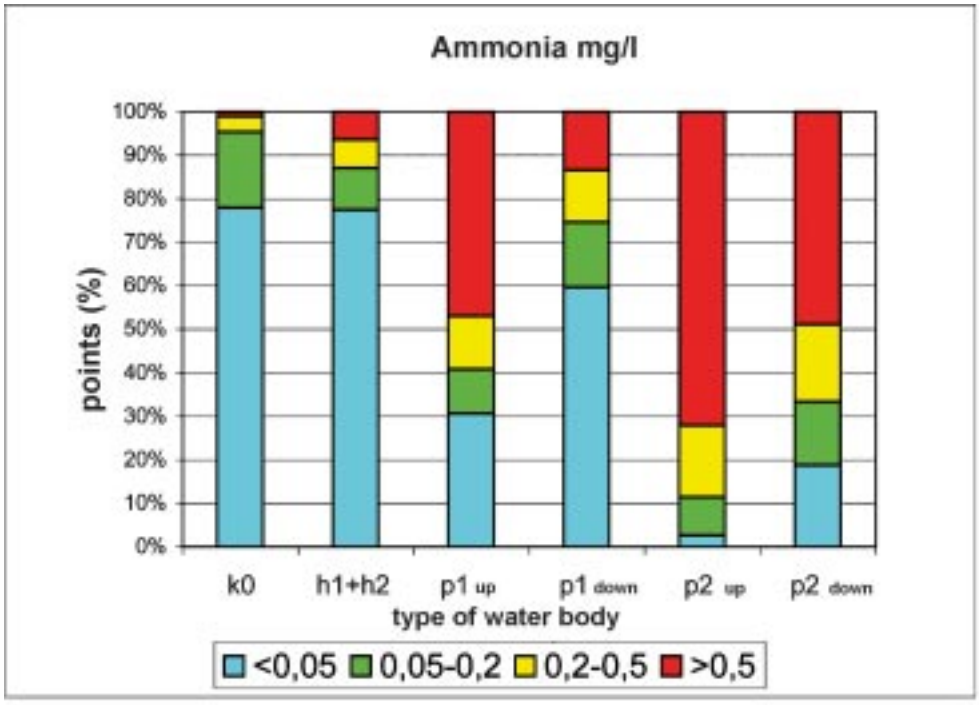
Some pesticide residuals were detected in the water of near-surface aquifers, and in the vicinity of industrial pollution sources a. o. heavy metal contaminations were observed.

Hungarian **legislation** in harmony with the EU directives and with the international practice serves as an appropriate basis for the protection of groundwater. The Government Decree No. 219/2004. (VII. 21.) Korm. on the protection of groundwater designates areas of various sensitivity in terms of groundwater status and the protection of groundwater quality on regional scale (**Figure 24.**) based mainly on the extension of near-surface formations transmitting pollution, and taking into consideration the conditions of infiltration enabling recharge. Nitrate vulnerable areas published in the Annex of Government Decree No. 27/2006. (II. 7.) Korm. were designated in harmony with the above mentioned sensitivity ranking (**Figure 25.**). (It is expected to be replaced by a delimitation based on the agricultural parcel patch identification system (MePAR), which enables a more adequate adjustment to hydrogeological borders and which is expected to be published in a ministerial Decree in the first half of 2006.)

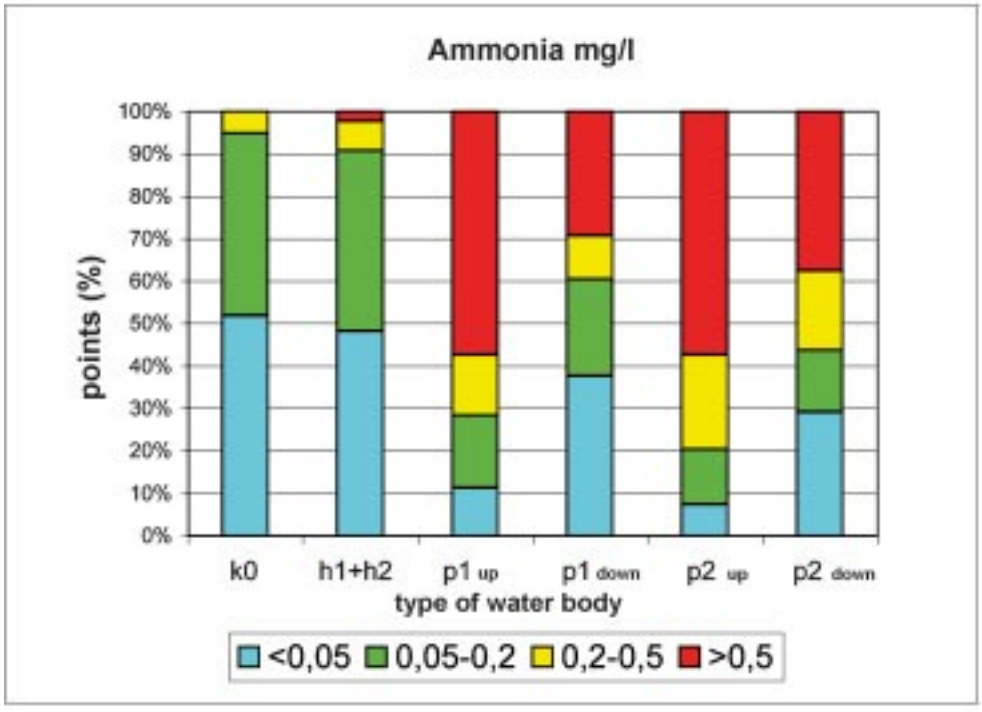
In addition to the general, regional protection **enhanced protective measures** are necessary in the case of drinking water, mineral and medicinal water resources (**Figure 23.**). For this purpose protection blocks and areas are designated in the various zones of which the activities endangering the quality of groundwater are to be limited to various extent (Government Decree No 123/1997. (VII. 18.) Korm. on the protection of the actual and perspective sources and the engineering structures of drinking water supply). The government launched a large-scale action programme in 1996 relating to the vulnerable active and perspective drinking water resources (such are the karstic, bank-filtered, shallow groundwater- and shallow confined groundwater resources) in the framework of which the protective blocks and areas are being designated based on detailed investigations. The monitoring systems indicating the changes in water quality or in the hydraulic conditions influencing it are developed in this process as well.

The estimated capacity of the 624 vulnerable drinking water resources kept on file and being in operation is 3 million m^3/day and the present rate of abstraction is 1.9 million m^3/year. The diagnostic phase has been finished in the case of 225 drinking water resources up to now. Potential vulnerable drinking water resources were mainly designated in areas with coarse-grained formations along watercourses, and only two of them in karstic areas. Estimated capacity of the 80 designated water resources is about 2 million m^3/d. In the case of 46 water resources of the latter the tasks of the diagnostic phase have been finished.

In the course of the determining the quality risk risk according to the EU Water Framework Directive, diffuse pollution sources of large extent (primarily the nitrate, different pesticides and phosphorus content), the large amount of point pollution sources (920 landfills and deposits, and 730 animal farms without proper technical protection), as well as the available monitoring and other hydrochemical data were taken into consideration. 45 water bodies were classified as being possibly at risk based on nitrate pressure calculations; the analysis on pesticides showed no water body in danger. In case of the point pollution sources none of the water bodies exceeds the ratio of areas with potentially

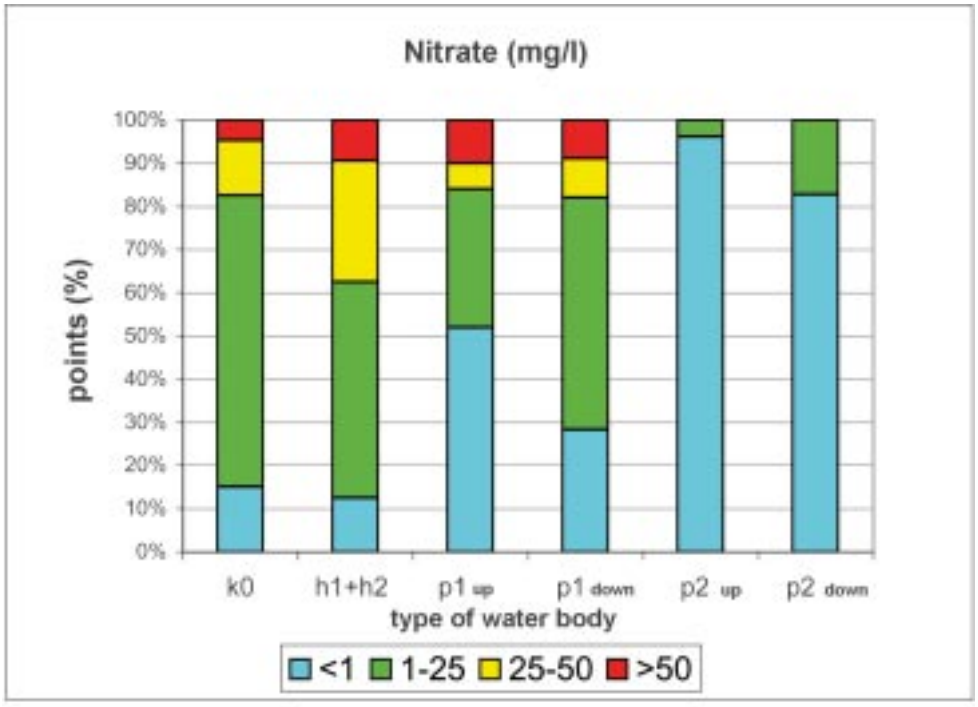


Evaluation of data of the year 2004
on the basis of mean values by points for cold types of water bodies

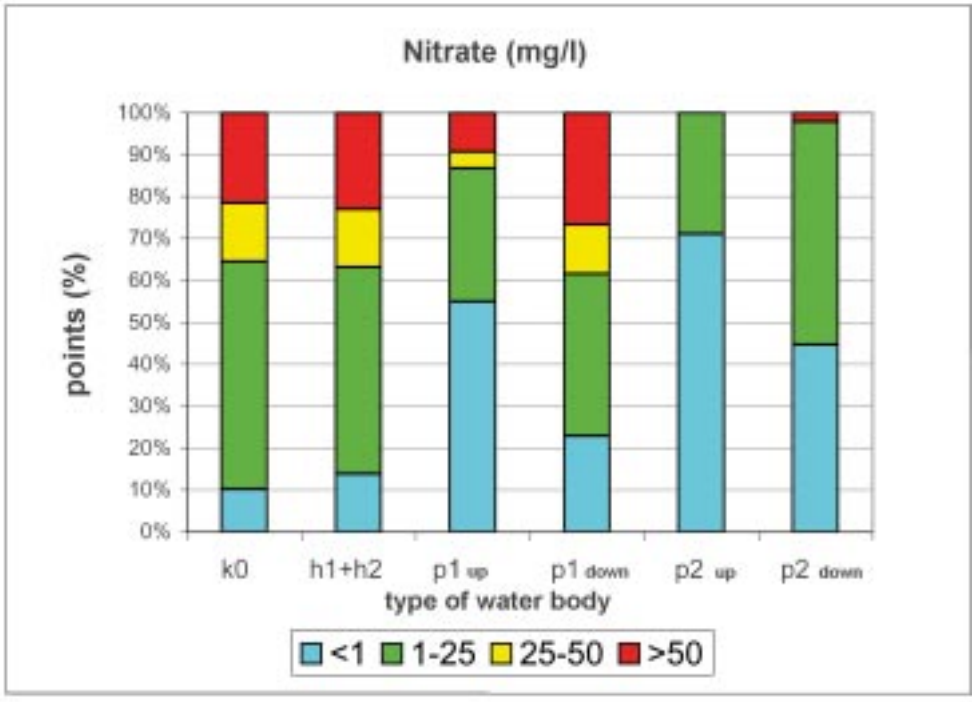


Evaluation of the data of environmental groundwater monitoring system on the basis of the mean values by point for cold types of groundwater bodies, year 2004

Figure 18.
Distribution of Ammonium in the various types of water
(k=carstic, h=mountainous, p=porous, up=upwards flow, down= downwards flow, depth:1=<50 m; 2=>50 m)



Evaluation of data of the year 2004
on the basis of mean values by points for cold types of water bodies



Evaluation of the data of environmental groundwater monitoring system on the basis of the mean values by point for cold types of groundwater bodies, year 2004

Figure 19.
Distribution of Nitrate in the various types of water
(k=carstic, h=mountainous, p=porous, up=upwards flow, down= downwards flow, depth:1=<50 m; 2=>50 m)

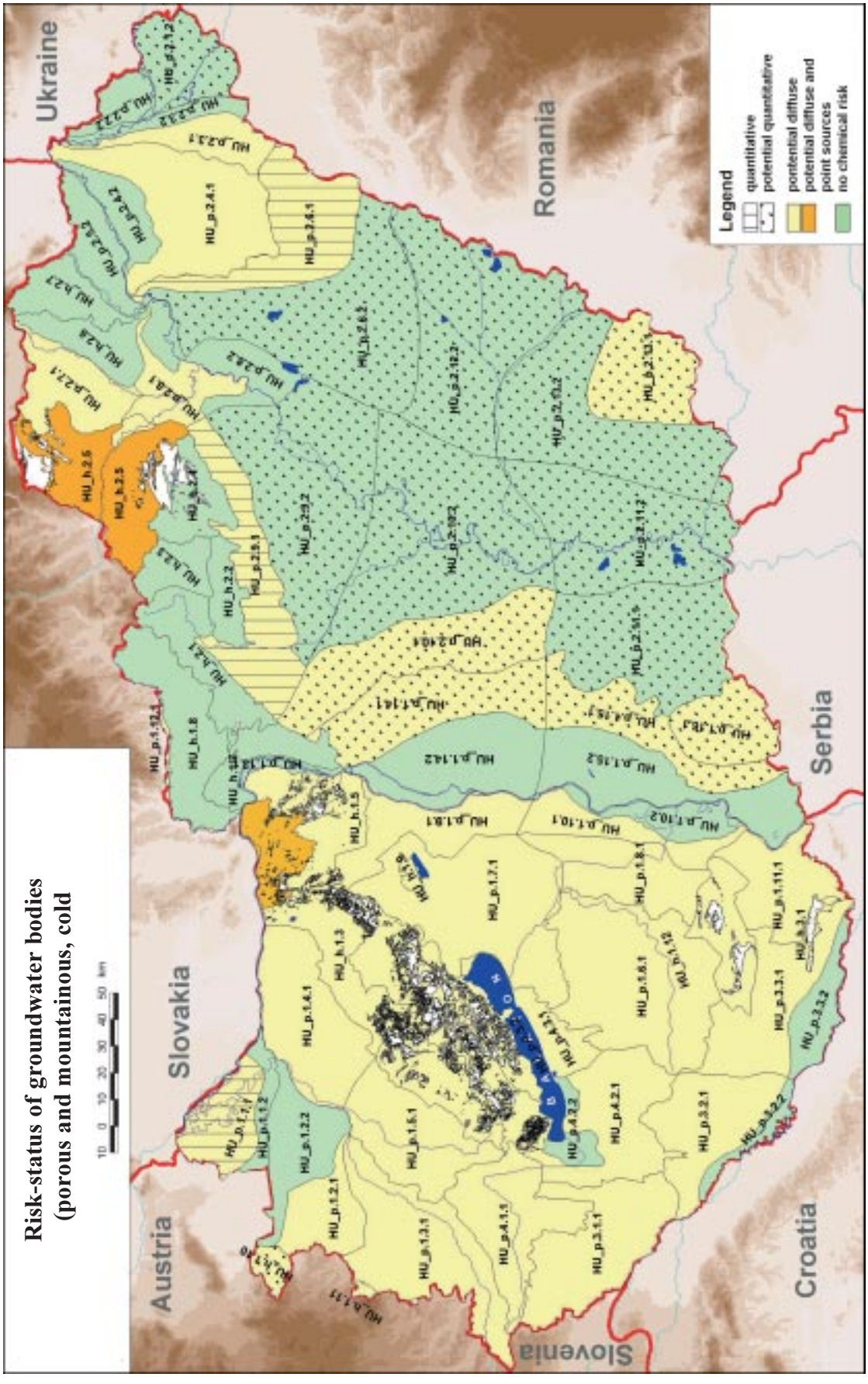

Risk-status of groundwater bodies
(porous and mountainous, cold
Legend
quantitative
potential quantitative
pontential diffuse
potential diffuse and
point sources
no chemical risk
Ukraine
Romania
Serbia
Slovakia
Austria
Croatia
Slovenia

Figure 20.

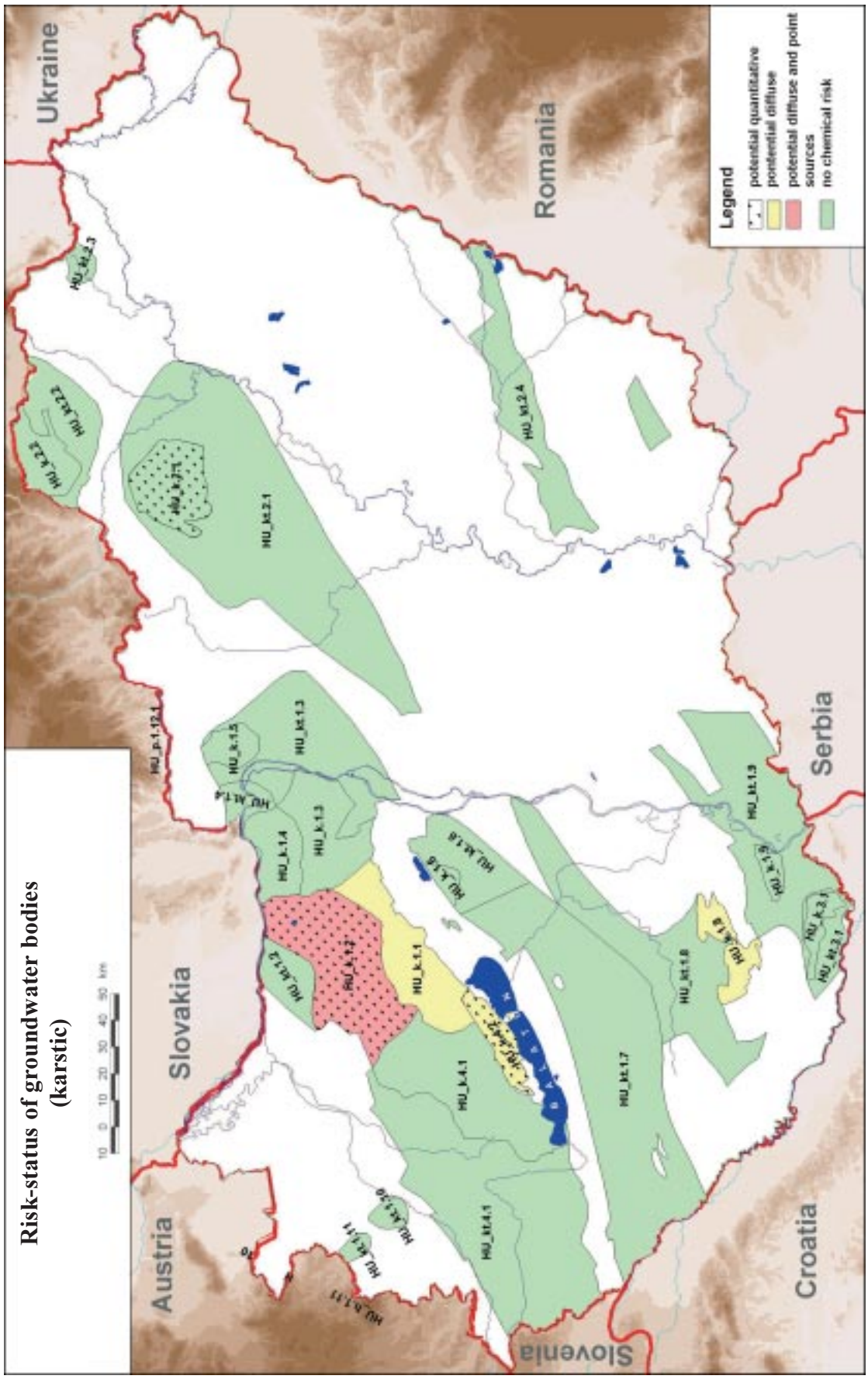

Risk-status of groundwater bodies (karstic)
Legend
potential quantitative
potential diffuse
potential diffuse and point sources
no chemical risk
Ukraine
Romania
Serbia
Croatia
Slovenia
Austria
Slovakia

Figure 21.

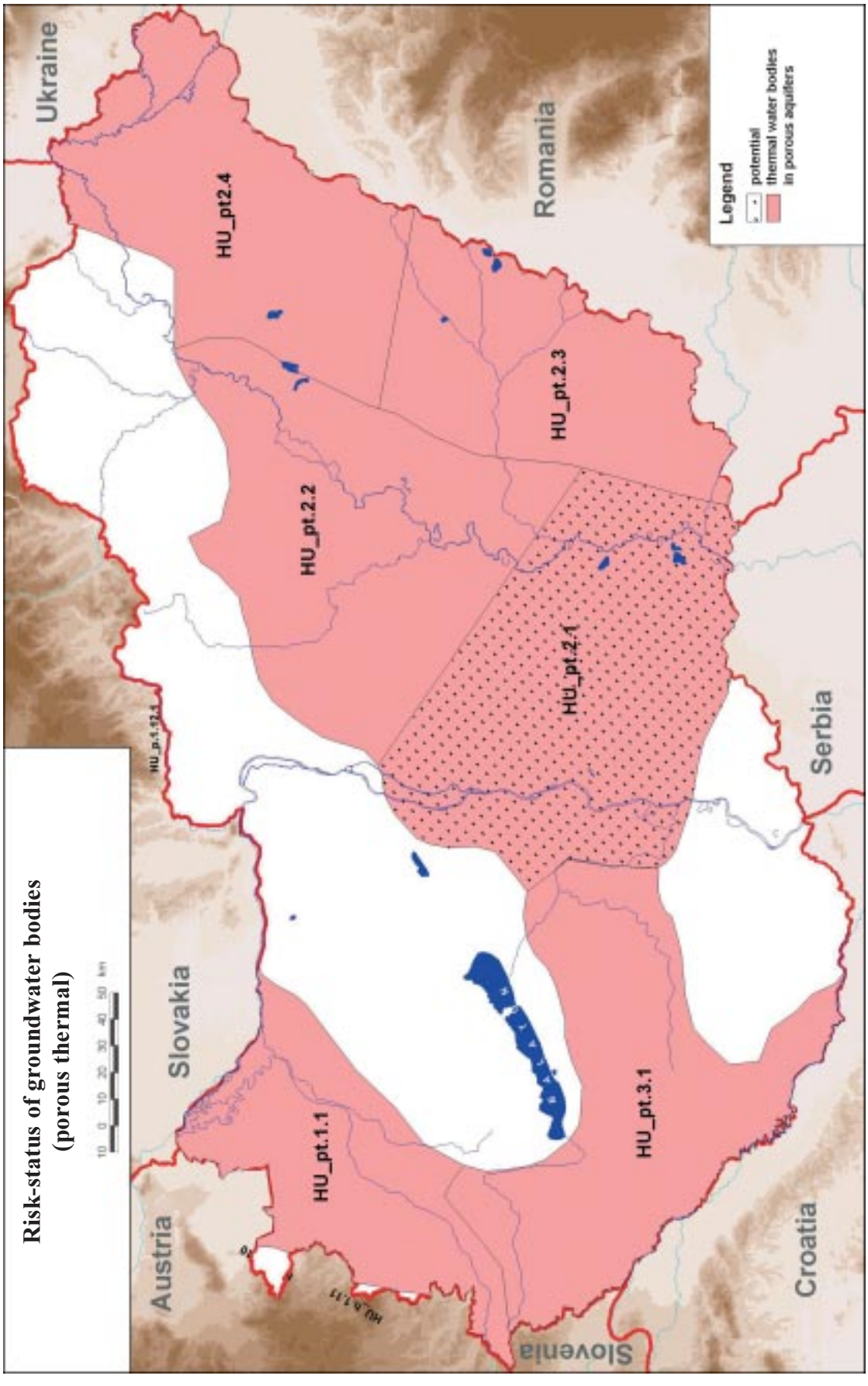
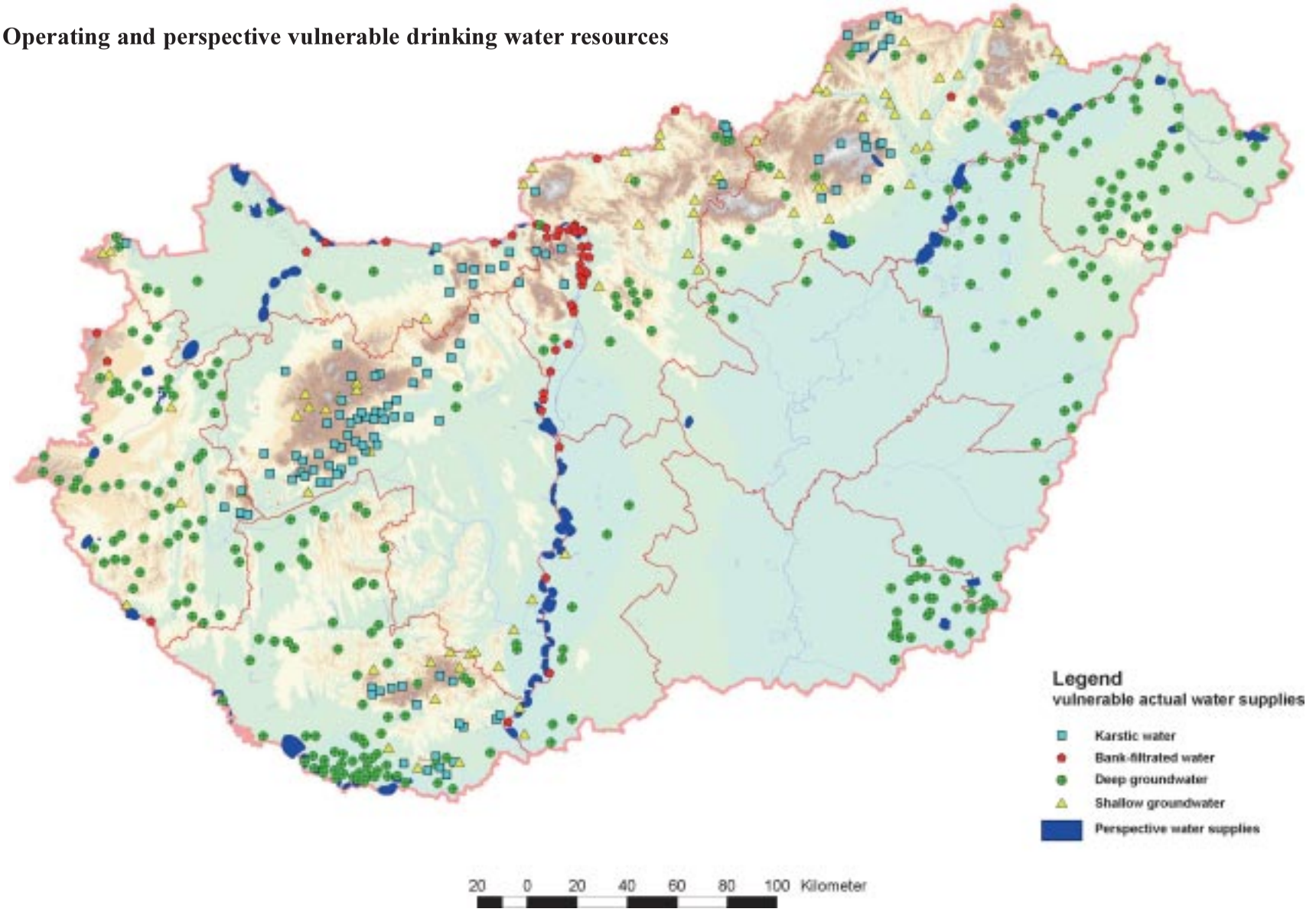

Risk-status of groundwater bodies
(porous thermal)
Legend
potential
thermal water bodies
in porous aquifers
Ukraine
Romania
Serbia
Slovakia
Austria
Slovenia
Croatia
HU_pt2.4
HU_pt.2.3
HU_pt.2.2
HU_pt.2.1
HU_pt.1.1
HU_pt.3.1

Figure 22.

Figure 23.

Operating and perspective vulnerable drinking water resources



Areas sensitive in terms of groundwater status

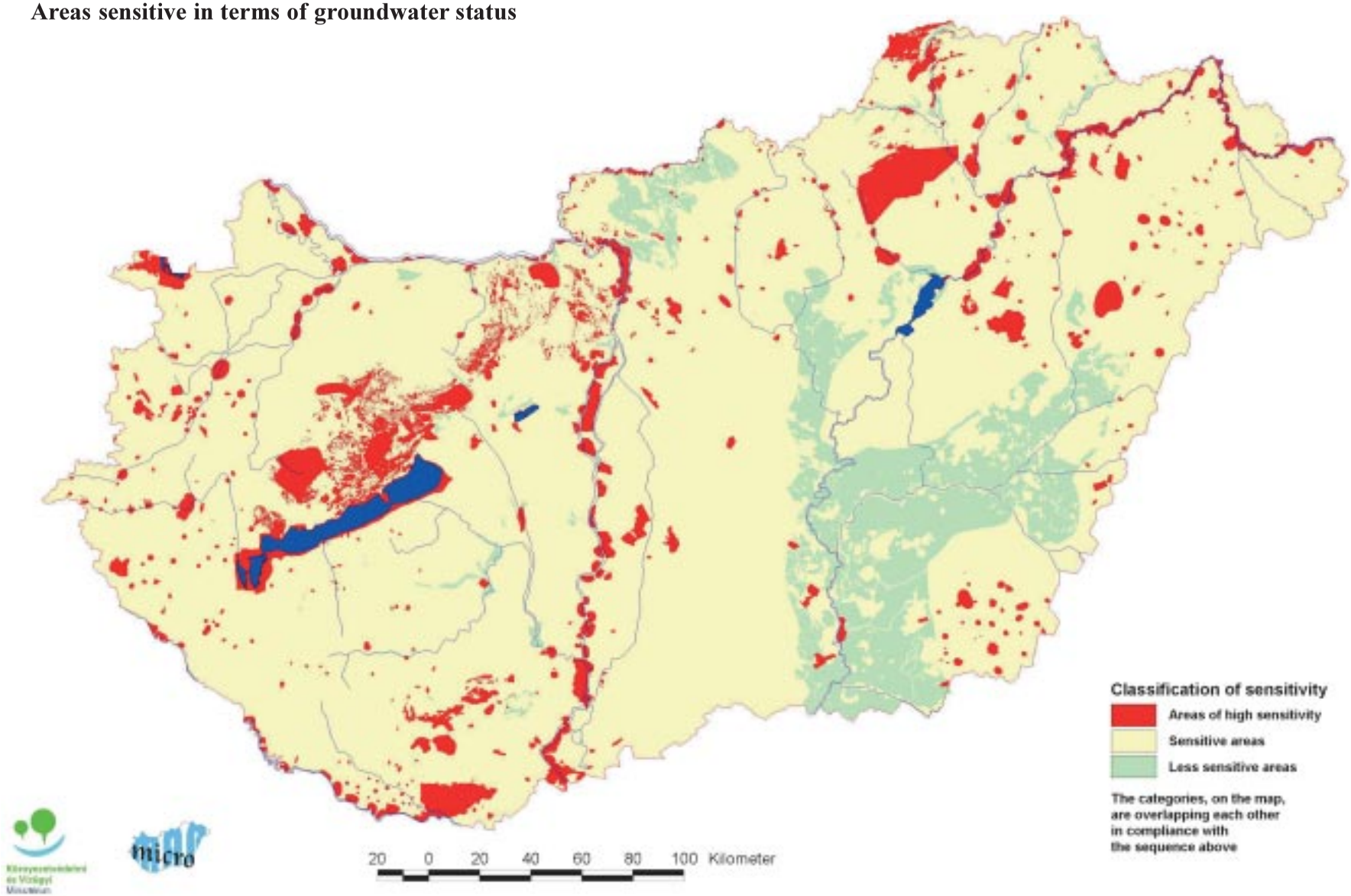


Figure 24.

Nitrate vulnerable zones (s. a. Annex 1/d)

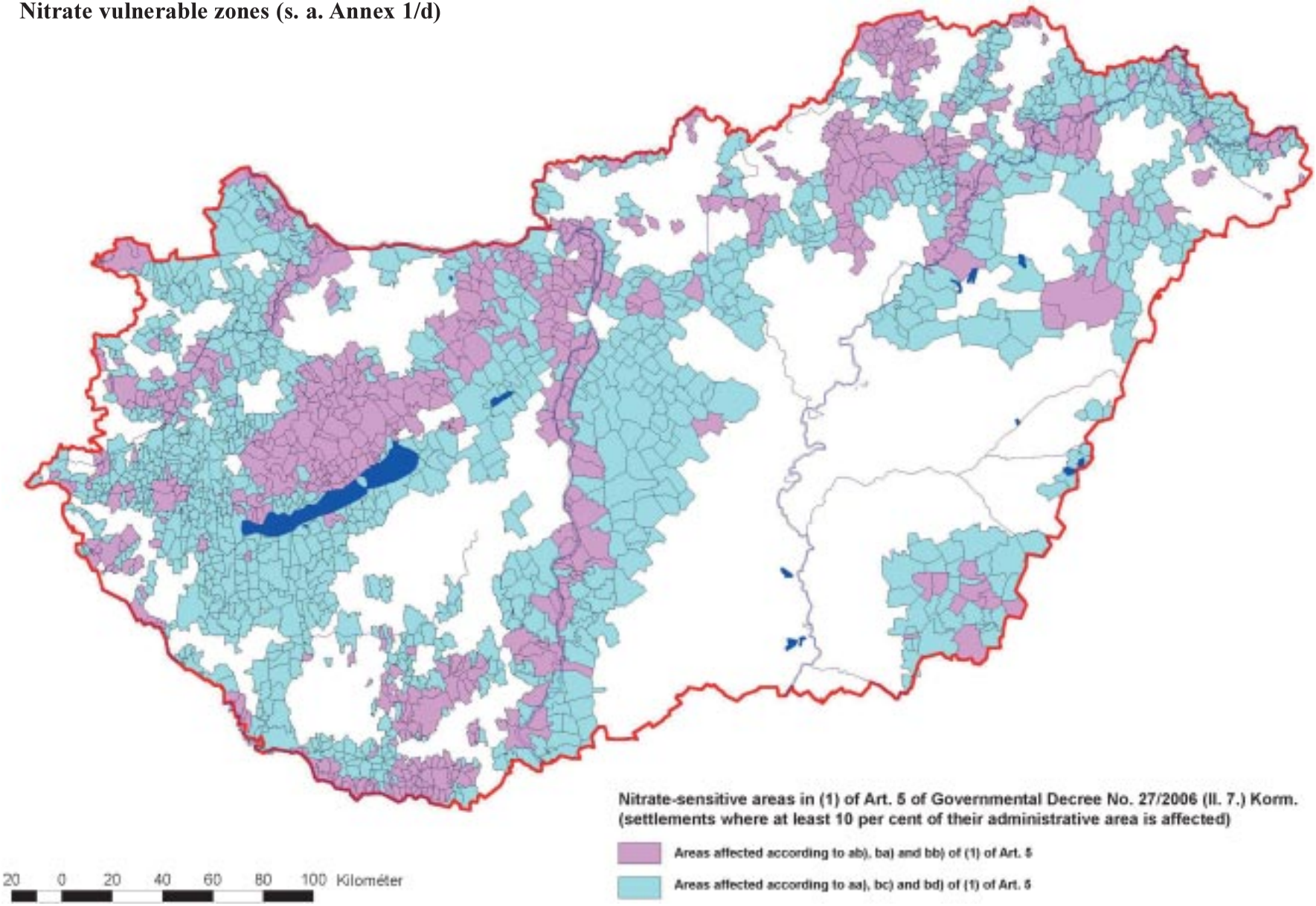


Figure 25.

polluted recharge the critical 20 percent, three water bodies however were classified as possibly at risk (one karstic and one mountainous water body near Dorog, and one mountainous water body in the Northern-Borsod industrial area). Re-injection of groundwater (artificial recharge into shallow groundwater for purpose of drinking water supply, re-injection of thermal water used for energetic purposes or oil production) does not pose a risk on groundwater quality under the present conditions taking into consideration the strict legal regulations. (A water body is at risk if it is not likely to achieve good qualitative status by 2015; it is possibly at risk if the determination of the former criterion needs further investigations.)

The qualitative risk-status of groundwater bodies, together with the quantitative risks is shown on **Figure 20. to 21.**

The groundwater quality monitoring until the near past consisted mainly of points selected from abstraction wells (593 sites). This network has been extended in the recent years, as it had not covered the near-surface zone mainly affected by pollution. In the framework of the so-called environmental monitoring in addition to the already existing networks in the Szigetköz area and the Danube-Tisza Interfluvial new sites were included in the Dráva River valley to observe accidental water pollutions along water courses (mainly in transboundary waters), in agricultural areas connected to the so-called TIM points (Soil Information Monitoring), in some areas with sewage irrigation and in settlements in order to extend the monitoring of the quality of the shallow aquifer zone; further, there is a regular sampling of springs. At present 842 wells and springs of the monitoring system are sampled once or twice a year.

Network development tasks carried out by a consortium led by the Geological Survey of Finland (GTK) and supported by PHARE is in the process of completion. In the course of the aforementioned project 650 new shallow groundwater observation wells are being constructed, and many springs and existing wells are being sampled. Based on the results of the developments carried out until now and on the aforementioned PHARE project the groundwater quality monitoring network will be constructed meeting the requirements of the EU Water Framework Directive by the end of 2006.

In the countrywide characterisation of groundwater, quality data acquired in the course of well construction and operation will be of great importance in the future too, as well as the monitoring systems of active and perspective drinking water resources and the local networks being established to monitor pollution sources and contaminated sites; and in addition to the basic geological information data on the pressures caused by diffuse and point and pollution sources are necessary as well.

IMPORTANT INTERNATIONAL AND NATIONAL LEGISLATION ON GROUNDWATER (summary)

The Water Framework Directive of EU (Directive of the European Parliament and of the Council 2000/60/EC of 23 October 2000 establishing a framework for community action in the field of water policy)

The objective of the Directive is to establish a framework for the protection of waters, among them for the protection of groundwater, which a. o.

- *prevents further deterioration and protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems,*
- *promotes sustainable water use based on a long-term protection of available water resources,*
- *aims at enhanced protection and improvement of the aquatic environment inter alia through specific measures for the progressive reduction of discharges, emissions and losses of priority substances and the cessation or phasing-out of discharges, emissions and losses of the priority hazardous substances,*
- *ensures the progressive reduction of pollution of groundwater and prevents its further pollution.*

The Directive applies basically the river basin approach. However it should be taken into account that the borders of river basins (catchment areas) are adjusted to surface waters, so they do not coincide completely with those of groundwaters, and that the national borders (among them the borders of EU) are frequently crossing the natural catchment areas. The Directive lays emphasis on the control of transboundary groundwater resources as well.

The Directive prescribes the setting of environmental objectives relating to groundwaters as well. The main issue is to maintain the balance of withdrawal and recharge and to prevent or reverse the deterioration of the qualitative status of groundwater:

- *in terms of quantity groundwater is in good status if water level changes of anthropogenic origin do not cause alterations in surface waters influencing terrestrial ecosystems and when they do not cause changes in the flow direction thus leading to the deterioration of water quality,*
- *groundwater is in good chemical status if the concentrations of pollutants do not exceed limit values on quality applicable under the relevant Community legislation and they do not result in any significant damage to terrestrial ecosystems directly or indirectly (through associated surface waters) dependent on groundwater and if no spreading of any pollution can be demonstrated.*

To the implementation of the environmental objectives the Directive prescribes deadlines to be strictly kept, which may be postponed to a limited extent only. The “good” chemical and ecological status of surface waters and the “good” quantitative and chemical status of groundwater have to be reached by the year 2015 on the whole.

The provisions should not be considered violated if they could not be implemented because of unforeseen or exceptional circumstances like droughts in connection with groundwater levels in Hungary. Impacts should be investigated also in these cases and all possible measures should be taken to restore the original status.

The Directive regulates the monitoring of water status, among those that of groundwater as well. Observations have to be extended over all groundwaters, however monitoring frequency should be increased where the achievement of environmental objectives is doubtful

and near the state borders. The primary objective is to provide information for the evaluation of the long-term changes brought about by natural processes and/or anthropogenic activities. The Directive calls for the monitoring in the form of periodic surveys, systematic observations at specific sites and special tests under exceptional circumstances.

The Directive prescribes to register the protected areas (among them the protection zones serving the preservation of groundwater) furthermore the identification of all bodies of water used or intended to use for the abstraction of water for human consumption providing more than 10 m^3/d or serving the water supply of more than 50 persons. Water bodies providing more than 100 m^3/d has to be monitored.

The Directive prescribes the characterisation of river basins (including also groundwater). More detailed characterisation is required where the achievementof good status may be difficult. River Basin Management Plans should be produced and updated regularly providing the ways of how to achieve the environmental objectives and the necessary measures. States have to report these and the results to the European Union at regular intervals.

The Directive orders the elaboration of action programmes in order to mitigate pressures on and the pollution of waters. With certain exceptions the Directive prohibits all activities involving the direct discharge of polluting substances into groundwater.

The Directive contains numerous other provisions as well. The implementation of the provisions and measures should be summed up in the River Basin Management Plans covering the area of a river basin and/or the relevant countries. The plans have to be reviewed every six years.

In Hungary the harmonisation of the Directive and the implementation of the provisions should be completed by the same deadlines as in the old member-states of the EU. A basic requirement of the implementation of the Directive is the implementation of other directives referred to in the Directive.

The Ministry for Environment and Water published an informative brochure on "The present state of implementation of the EU Water Framework Directive in Hungary and the Danube-catchment area" in 2005; the brochure provides the summary of the Hungarian report sent to the EU by the deadline stated in the WFD.

In addition to the WFD the following two directives are of outstanding importance terms of groundwater protection:

– *the so-called Groundwater Protection Directive (80/68/EEC)*
(Its Hungarian adaptation is the Government Decree No. 219/2004. (VII. 21.) Korm. on the protection of groundwater), and

– *the so called Nitrate Directive (96/676/EEC) (The Hungarian adaptation is the Government No. 27/2006. (II. 07.) Korm.).*

The Council Directive 80/68/EEC deals with the protection of groundwater against pollution caused by certain dangerous substances. It classifies dangerous substances into List I and List II depending on the level of danger caused by the relevant substances.

The Directive differentiates between the direct discharge into groundwater and the case when the polluting substances reach groundwater after percolating through the unsaturated zone (indirect discharges). The Directive prohibits the direct discharge of List I substances and prescribes that all activities possibly leading to the indirect discharge of List I substances and/or the direct or indirect discharge of List II substances are subject to authorisation. Authorisation may be granted only if prior investigation proved that the concentration of contaminants in groundwater would not exceed an inadmissible level. The authorisation may be granted for limited period only and it has to be revised at least every 4 years. The authorisation should define the conditions of the activ-

ity to be performed, and specify the monitoring of discharge and of the impacts (if the implementation of the latter is realistic). The measurements and observations should be documented. Member states are obliged to report on the activities covered by the Directive. The content of reports is regulated separately.

The **Nitrate Directive** (**911676/EEC**) covers the protection of waters against pollution caused by nitrates from agricultural sources. All waters and their catchment areas as well should be declared vulnerable against nitrate pollution where the nitrate content of the water already exceeds 50 mg/l, or where it may exceed this value if the rules of "good agricultural practice" are not be followed. The rules of "good agricultural practice" apply to the installations of animal breeding, the storage and agricultural use of solid and liquid manure and the rules on water protection of other agrotechnical activities. The application of "good agricultural practice" is obligatory in the nitrate-vulnerable areas. For the purpose of the implementation of tasks action programs should be established every four years. The Directive prescribes the obligation of data reporting as well.

The directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment, the directive 97/11/EC amending the former, as well as the directive 96/61/EC concerning integrated pollution prevention and control prescribe the application of the environmental impact assessment and the unified permits on environmental use prior to granting the permits of construction on activities having significant effects on the environment. The two gorvernment decrees earlier in force, which were prepared to harmonise the aforementioned directives were synthesized by the end of 2005.

The Government Decree No. 314/2005. (XII. 25.) Korm. on environmental impact assessment and the uniform environmental use permits harmonises the two authorisation procedures, thus making it faster and more flexible.

Government Decree No. 74/2000. (V. 31.) Korm. on the announcement of the Convention on the Protection and Sustainable Use of the Danube River done in Sofia on the 29th June 1994.

The scope of the Convention announced by the Decree concerns the Danube River basin and the watercourses therein, however it defines the preservation, improvement and rational use of groundwater among the objectives and principles. Particular reference is made to the long-term protection of groundwater resources and the existing and intended protection zones important for the present and the future drinking water supply, to the prevention of deterioration of groundwater resources (caused mainly by nitrates, herbicides, pesticides and other harmful substances).

National legislation

Annex 1 lists the most important legal regulations referring to groundwater. A short summary of the most significant regulations can be found below.

Act LIII of 1995 on the general rules of environmental protection

This Act contains the fundamental rules of the protection of waters, among them those of groundwater. It prescribes the general rules of the protection of environmental elements including those of groundwaters.

The Act prescribes the general rules of the protection of environmental elements, groundwater included. It defines a. o. the fundamental elements of protection (precaution, prevention, remediation, responsibility, cooperation, collecting and providing information, and publicity). It declares the general requirement of the consistent protection of the environmental components on one hand, and contains the basic rules of water protection on the other.

As far as groundwater is concerned, consistent protection refers to the consideration of the interactions with surface waters on one

hand and entails the harmonisation of the protection both of groundwater and the geological medium (topsoil included).

The Act declares that when using the environment "waters shall remain as a factor of the landscape; the conditions necessary for the survival of the aquatic and riparian flora and fauna as well as the quantity and quality conditions ensuring the potential use of water shall not deteriorate."

Compared with the general level of quality protection [specified mainly by the Government Decree No. 219/2004. (VII. 21.) Korm.] drinking water resources and those serving the utilisation of mineral and medicinal waters should be specially protected. (Special rules concerning such resources are defined by the Government Decree No. 123/1997. (VII. 18.) Korm.

The Act prescribes that in the framework of state responsibilities for environmental protection among others the quantity and quality objectives (target state) for the environmental elements should be defined.

The quantity objective (target value) for groundwater comprises the following tasks of outstanding importance:

- *hampering the decrease of groundwater level (pressure head), ensuring and promoting its regeneration, the recovery of the water household in the endangered regions,*
- *developing the equilibrium of abstraction and recharge so that the level of near-surface water (shallow groundwater and open karstic waters) does not fall below the long term quasi-natural average due to anthropogenic activity, except in the immediate vicinity of the abstractions,*
- *no unfavourable change of water quality because of the new hydraulic conditions resulting from the abstraction of water should ensue.*

The Act prescribes the establishment of environmental requirements to the control of discharges and the quality protection of recipients. These may be among others the various limit values.

The Act differentiates several kinds of licensing processes as they follow:

- *environmental permit based on environmental impact assessment,*
- *unified permit to the use of the environment,*
- *environmental operation permit based on environmental audit.*

The Government Decree No. 219/2004. (VII. 21.) Korm. on the protection of groundwater aims at the determination of tasks, rights and obligations associated with the ensuring and maintaining of the good status, and the progressive reduction and prevention of pollution of groundwater; a sustainable water use based on the long-term protection of available groundwater resources and the remediation of the geological medium. The Decree applies – with the exception of substances and activities falling under the scope of a separate piece of legislation on nuclear power – to the groundwater, the geological medium and to the activities affecting their status and pollutants.

To the deposition of hazardous, non-hazardous, as well as of inert wastes decrees falling under the authorisation of the **Act XLIII. of 2000 on Waste Management** applies. Requirements included in those decrees should be applied by consideration of the Gov. Decree No. 219/2004. (VII. 21.) Korm. The same applies for the construction of inflammable fluid deposits or the disposal of other dangerous substances if the activity falls under the scope of a piece of legislation in force. In case of activities without similar regulation specifications and directions in standards, guidance and different kinds of reference books should be taken into consideration when planning a facility so that no admissible pressure on the geological medium or groundwater is caused by the activity.

One fundamental principle stated in the Decree is that the status of groundwater bodies should meet the objectives of good qualitative and quantitative status by the deadline

referred to in the Act on the General Rules of Environmental Protection. To meet these objectives compliance with the following criteria should be ensured, so that no deterioration of status take place; all significant and sustained adverse trends in groundwater status be reversed; criteria for good quantitative and qualitative status of groundwater bodies – except in the case of water bodies at risk – be fulfilled and the status of water bodies at risk progressively improve. Groundwater and geological medium permanently damaged should be registered and controlled, and their status be improved by remediation. The status of groundwater is determined by the poorer out of the quantitative and qualitative status.

A groundwater body is in good quantitative status, if the long-term (min. 10 years) annual abstraction rate does not exceed the available groundwater resource; and the abstraction does not cause sustained decrease in groundwater level or groundwater pressure level in any part of the water body; furthermore environmental objectives for the associated surface waters specified in a separate piece of legislation are achieved. Further criteria are that alterations to flow direction may not result in a sustained deterioration of status and that no terrestrial ecosystem directly dependent on groundwater is damaged. Good quantitative status should ensure that environmental objectives defined for the physical and chemical status of groundwater can be achieved without hindrance.

A groundwater body is in good chemical status, if changes in its quality characteristics do not result in a significant and sustained deterioration of qualitative status and/or a significant change of natural physical and chemical status and/or a deviation from the qualitative limit values established in a piece of legislation or in the river basin management plan. Alterations of the qualitative status of groundwaters may not result in a significant deterioration of ecological or chemical status of associated surface waters, and/or in the damage of terrestrial ecosystems directly dependent on groundwater as a consequence of poor water quality.

Certain changes to the aforementioned objectives may be introduced for water bodies at risk exclusively as specified in a separate piece of legislation (Gov. Decree No. 221/2004. (VII. 21.) Korm. on the rules of river basin management).

In order to achieve environmental objectives groundwater bodies have to be designated, registered, their status should be monitored and the impacts affecting them evaluated on a regular basis under consideration of the pressures from point and diffuse pollution sources.

The abstraction limit value ("M_i") which means the total annual volume of water (in m^3/year) that may be withdrawn with the highest permitted range of water level decrease should be determined for the different parts of the water body ensuring that abstractions do not endanger natural quality of groundwater, do not cause any deterioration in the qualitative status, including changes associated with infiltration from surface water and do not result in failure to achieve the objectives established for surface waters and terrestrial ecosystems directly dependent on groundwater.

Based on the report prepared for the European Commission and the river basin management plans measures should be taken to reverse significant and sustained adverse trends in groundwater bodies where indicative parameters of the status have reached the pre-established starting point of reversal. Measures should be taken to enhance the status of water bodies at risk and to prevent potential deterioration, or to enhance the status of groundwater, if deterioration exists, in areas of high sensitivity.

Starting point mentioned above means the average value of concentration for the upper 50 metres of the groundwater body reaching 75% of the pollution limit value (B) in respect of nitrate and pesticides (s. a. **Annex 1/a.**). (Changes in groundwater temperature should be considered as trend reversal points in case they endanger good status.) If the verified background concentration (Ab) exceeds 50%

of the pollution limit value (B) the Environmental Inspectorate identifies the necessary measures in a specific procedure.

For water bodies at risk the inspectorate should – based on the river basin management plan and the review of the activities posing a risk on the achievement and maintaining of the good status – modifies or withdraws licences, it may ordain an environmental impact assessment, initiates the completion or modification of monitoring and if necessary modifies the environmental objectives determined in their earlier decisions or initiates the modification of the relevant prescriptions.

According to the Decree Hungary's territory is classified as areas of high sensitivity, sensitive and less sensitive areas (s. a. **Annex 1/c**) on the basis of the sensitivity of the groundwater status and the protection of the water quality taking into consideration the recharge of groundwater, hydraulic conductivity of the geological medium, further the areas under special protection as shown on the 1:100 000 scale map available at VITUKI Kht.

(Administrative areas of settlements are categorised on the basis of the same map: settlements fall into the higher sensitivity categoriy if it covers at least 10% of their territory.)

The list of settlements so classified can be found in the Annex of the **Ministerial Decree No. 27/2004. (XII. 25.) KvVM on classification of settlements located in sensitive areas in terms of groundwater status**.

The environmental inspectorate may apply special sensitivity classification for a defined area based on local investigations carried out by the user of the environment.

In order to promote the use of the sensitivity maps the Ministry for Environment and Water published the booklet *"Commentary to the maps showing sensitive areas in terms of groundwater status according to Annex 2 of the Government Decree No. 219/2004. (VII. 21.) Korm. on the protection of groundwater"* in 2005.

In order to ensure the good status of groundwater the activities defined by the Decree should be carried out only by implementing preventive environmental measures with applying the best available technology and the most efficient solution specified in a separate piece of legislation, under controlled conditions, the establishment and operation of a monitoring network and data supply included. The activity must not threaten the achievement of the environmental objectives even in the long term.

In addition to the aforementioned requirements further rules are in force to ensure the good qualitative status:

- *excavation (dredging) of the river-bed material, or alteration of river-bed conditions should be carried out only with respect to the environmental objectives for groundwater and the objectives for the protection of drinking water resources specified in a separate piece of legislation, and*
- *in areas of extremely high sensitivity in terms of groundwater status the following activities – except for the activities defined in the river basin management plan – are prohibited: the supplementary alimentation of surface water from groundwater; any activities resulting in the removal of the top layer causing groundwater to appear on the land surface; as well as any mining activities where the level of mine underside, sunk by dislodging of surface formations, approaches the highest level of karstic water to 10 meters.*

In sensitive areas the aforementioned activities may be performed only if certain requirements are met, no restrictions are stated for the less sensitive areas.

The quantitative groundwater protection may be increased by artificial recharge of groundwater, by the use of a closed system in the case of the utilisation of geothermal energy or by the re-injection of abstracted water into the same aquifer, or in another one used for the same purpose. The latter applies also to re-injection of row water extracted in the course of mining, civil engineering and maintenance works. It has to be ensured that

there are no any substances in the re-injected water different from those in abstracted water, and that it causes no negative changes in water quality.

In order to ensure good qualitative status of groundwater activities connected with the use or disposal of pollutants, and substances transforming into pollutants as a result of their degradation, may only be carried out with technical protection and with the preservation of the status of groundwater and the geological medium in a state superior to the pollution limit value (B) as far as it is possible.

The activity should not result in the qualitative status of groundwater and geological medium being poorer than the pollution limit value (B) or the verified background concentration (Ab), further the specific pollution limit value (E) established for a particular site in thecase of activities carried out by the time of coming into force of the Act on environmental protection, or the remediation target limit value (D) related to remedial actions. Definitions of the limit values are listed in **Annex 1/a**.

Discharge or disposal of certain substances as a part of the activity is subject to a permit.

Hazardous substances classified as K1 and K2 on the basis of the relevant EU legislation are listed in the Annex of the Decree (**Annex 1/b**).

The direct discharge of such substances into groundwater, their introduction into artificial lakes, originating from the excavation of the geological medium and consequently resulting in the exploration of groundwater, especially in the case of introduction into residual lakes derived from mining activity and lakes used for recreational purposes, and their disposal in deep working mines (except for some certain cases) is prohibited.

In areas of high sensitivity in terms of groundwater status indirect discharge, including discharge into intermittent watercourses is also prohibited. In case of discharges of cleaned municipal waste water into intermittent water courses, the inspectorate may give release from restrictions for certain substances according to a separate piece of legislation.

While authorising the activity the inspectorate may order the monitoring to control compliance with the requirements.

The disposal of pollutants by deep injection or by any kind of deep squeezing is generally prohibited, except the discharge into geologic formations that are permanently inadequate for other purposes and are considered to be confined in terms of pollution transport in the following cases: the re-injection of waters not containing K1 pollutants, originating from activities carried out in the scope of mining activities, including investigations, exploration and exploitation, the injection of waters of natural content to promote hydrocarbon production or injection of natural gas or liquefied natural gas for the purpose of storage provided that they do not result in the deterioration of groundwater quality.

The Decree specifies regulations on the authorisation of water abstractions, the disposal and introduction of pollutants, the notification of activities subject to a permit, as well as data reporting and inquiry.

The Decree describes the liability for remediation, the phases included in the remediation process (site investigation, technical intervention, monitoring), necessary measures in connection with permanent environmental damage and the Environmental Registration System for Groundwater and the Geological Medium (FAVI). The data sheets, as well as the guidance for their use and the annexes of FAVI are published by the minister of environment in the Ministerial Instruction 8001/2001. (Környezetvédelmi Értesítő 2002/2) currently in force, which will be replaced by a ministerial decree in the near future.

Among the legal consequences rules on imposing the groundwater pollution fine are specified in the Decree as well.

Implementation of remedial tasks, not depending on liability conditions, falls within the framework of the National Environmental Remediation Program (OKKP), the aims of which are a. o. the countrywide assessment and registration of pollution sources and contaminated sites in the FAVI-KÁRINFO system and the reduction of pollution to an admissible level by the use of authority measures.

According to the Decree persons liable for remedial actions are those who have carried out, or are carrying out the polluting activity, or have assumed the liability for environmental damage by acquisition of the proprietary rights over the polluted site or in any other way.
In case of pollution under state responsibility the competent state organ is obliged to take remedial measures.

Joint Decree No. 10/2000. (VI.2.) KöM-EüM-FVM-KHVM of the Ministers of Environment, Public Health, Agriculture and Regional Development and Transport, Communication and Water Management on limit values established for the protection of groundwater and the geological medium. Being in connection with the Governmental Decree No. 219/2004. (VII. 21.) Korm. the Decree sets the values of background concentration (as an information), and the pollution limit values separately for the geological medium and for groundwater (**Annex 3**), listing the standards to be applied as well.

The **Ministerial Decree No. 14/2005. (III. 28.) KvVM** specifies regulations concerning the screening investigations to be carried out in the course of remedial site investigation, and the **Ministerial Decree No. 27/2004. (XII. 25.) KvVM** lists settlements located in areas sensitive in terms of groundwater status, indicating also settlements in groundwater protection areas of extremely high sensitivity.

The **Ministerial Decree No. 30/2004. (XII. 30.) KvVM** on rules for the investigation of groundwater applies to the rights and obligations established for the designation of groundwater bodies, the characterisation and classification of their status, their monitoring, the review of the aforementioned tasks, as well as the investigation and monitoring of groundwater in general, and the collection, processing and reporting of data necessary for the execution of these tasks.

Designation of the water body includes its spatial delimitation, mapping of its location and its identification. In case of transboundary water bodies the designation should be concerted with the relevant country.

The water body should be identified by a name reflecting its geographical location and by a code, boundaries of the horizontal extent of the water body and – if known – the borders of its vertical extent should be presented in a geographic information system, in a database of digital maps with a resolution and content corresponding to the scale at least 1:500 000. Water bodies should be designated on the basis of the type and occurrence of the aquifer, namely groundwaters in

- karstic formations,
- non-karstic and porous formations of basin-areas,
- formations of non-karstic mountainous areas, and

the temperature of groundwater coming to the surface from the aquifers:

- cold groundwater which mean groundwater with temperature not exceeding 30°C,
- thermal groundwater which mean groundwater with temperature higher than 30°C,

furthermore inside the above classification the the subsurface catchment area, flow conditions, and the natural hydro-chemical composition of groundwater as well as the geological structure should be taken into consideration.

In the course of the designation it has to be considered that all aquifers (i. e. single strata or a set of strata of geological formations) of sufficient porosity and permeability to allow the abstraction of more than 10 m^3/d or the quantity necessary for the drinking water sup-

ply of more than 50 persons, as well as those capable to provide water abstraction of more than 100 m^3/d should be assigned to a designated water body.

The designation has to be reviewed and, if necessary, modified periodically due to various reasons.

Following the designation the status of water bodies should be characterised with special regard to protected areas designated and registered acc. to a separate piece of legislation, water bodies at risk, those parts of a transboundary water body, which may be affected by transboundary impacts arising from the activity, as well as those parts of the water body on which the recharge of surface water bodies or the maintenance of terrestrial ecosystems directly depends.

Further characterisation should be undertaken in the course of preparation of the river basin management plans to provide means for more exact prediction of whether the water body is to achieve the good status, to enable the selection of measures necessary to achieve the environmental objectives, and to enable a more precise identification of water bodies at risk. In case of the latter detailed analysis of the extent of deviation from the natural status of water bodies, its causes and impacts by focusing on the area, where adverse impacts are observed are necessary. A water body is at risk, if it is not likely to achieve the good status by 22 December 2015. despite the program of measures. (A water body may be at risk, if there is an adverse change in water(pressure)level, if available water resources, water abstractions, the verified and presumably existing pressures, in particular diffuse and point pollution sources, have an adverse impact on the quality and quantity of groundwater, on associated surface waters and terrestrial ecosystems, on covering layers, flow conditions and hydrogeological protection, if pollution is likely to have taken place, if there are contaminated sites on the water body, and even if data are insufficient for the evaluation of the above mentioned aspects.)

Within the water bodies those areas have to be designated, where the good chemical status cannot be achieved at all or within the planning cycle, or its achievement is disproportionately expensive, where the achievement of good quantitative status would provide adverse effects to the status of surface waters and aquatic or terrestrial ecosystems directly dependent on groundwater regarding the efficiency of watershed control, flood protection and drainage, or justifiable abstractions.

The impact of activities on groundwater should be analysed and qualified for each water body. The first assessment has to be completed as part of the works providing basis for the first river basin management plan, using data from the monitoring system of the water body under utilization.

Based on the results of characterisation water bodies should be qualified in terms of qualitative or quantitative status as good or poor; declining or improving tendencies, or no changes in status have to be indicated in each case as well.

For chemical components the mean values of monitoring data for each point in the groundwater body or group of bodies should be calculated, and should be further used in calculations specified in a separate piece of legislation to demonstrate whether the water body meets good chemical status criteria or not.

The monitoring program of the groundwater bodies comprises the collection and evaluation of the data of monitoring sites selected from the monitoring systems established for the observation of groundwater status and the associated surface waters, and from the systems providing hydrometeorological data.

The operation of the monitoring systems is the task of the organisations under the direction of KvVM, as well as of other state organisations and local governments in case of the regional monitoring; in case of the environmental monitoring the operators of abstractions, potential pollution sources and those of the remediation monitoring systems in contaminated sites provide for the opera-

tion of the systems. These systems have to be developed in an adequate way to provide monitoring sites for the water body monitoring system, and have to be operated in a way to provide observations satisfactory to its requirements. Parts of the water body monitoring are

- quantitative, and
- qualitative (chemical) monitoring.

Monitoring of quantitative status should support the assessment of quantitative status, including the selection and revision of the abstraction limit value (Mi) and an estimation of the available groundwater resources. For water bodies at risk from the point of view of their quantitative status, or in case of transboundary water bodies the density of monitoring points and frequency of monitoring should be determined so that they are appropriate for the inventory and control of the impacts of abstractions and discharges on groundwater(pressure)levels, as well as for the determination of the direction and rate of groundwater flows across the state boundaries.

In the framework of qualitative monitoring the surveillance monitoring of chemical status has to be appropriate to provide and validate all relevant information required for the determination of the impacts or the activity, to provide information for each period identified in the river basin management plan (in particular on oxygen content, pH-value, conductivity, nitrate, ammonium and parameters determining the ion composition of the water), and to support the design of the operational monitoring of chemical status.

It should consist of monitoring points of sufficient spatial density in water bodies at risk and transboundary water bodies in order to provide sufficient data for all pollutants, threatening the good chemical status of groundwater. In these areas the operational monitoring of chemical status should be operated in the periods between the surveillance monitoring programmes.

VITUKI Kht. should carry out the characterisation of water bodies and the assessment of groundwater status based on the data from monitoring systems.

Organisations under the direction of the KvVM should register the necessary data falling under their competence and should transfer them to VITUKI Kht. by 31 March of the year following the reporting year. Institutions under the direction of other ministers involved should provide the relevant data acc. to the specifications of a separate piece of legislation.

VITUKI Kht. also charges the function of the system administrator of the national databases.

The Government Decree No. 314/2005. (XII. 25.) Korm. on environmental impact assessment and the unified environmental use permits harmonises the two authorisation procedures, thus making them faster and more flexible.

In the environmental authorisation procedure a shorter, preliminary investigation process takes the place of the preparatory phase in the case of environmental impact assessment; the output of the preliminary investigation is not a permit, but detailed instructions are specified for user of the environment . The application in this case comprises only a short document serving as a basis for the environmental, nature protection and water inspectorate to come to a decision, by consulting expert authorities concerned and taking into consideration the opinion of the public, concerning the following:

- in case of a definite class of activities the authority may decide whether the significance of the environmental effects of activities require the conduction of an environmental impact assessment (for activities of the other class environmental impact assessment is obligatory in each case);
- in case of activities subject to environmental impact assessment (by legislation or as a result of authority decision) the content of the documentation to be submitted in the course of the environmental impact assessment procedure has to be specified; in case of activities subject also to the unified environmental use permit the possibility of the uni-

fied process instead of the two separate procedures should be investigated first. If the unified process is possible, the content of the documentation should be specified.

If the preliminary investigation reveals no significant effects to be expected, thus no environmental impact assessment is necessary the environmental permit is not required, since environmental interests are promoted by means of other procedures.

In case of activities subject to environmental permit the unified permit procedure takes place if in the preliminary investigation phase the authority decides so, otherwise the environmental impact assessment is followed by the unified environmental use permit procedure. The former variant reduces the total length of procedure.

In the case of new activities subject to a unified environmental use permit a consultation takes place in the course of the preliminary investigation to enable that the applicant supplies in an appropriate form the information required by the licensing procedure, and to enable that, if it is possible under the given circumstances, the procedure to be unified with that of environmental impact assessment supplementing the former.

If no unified procedure is possible the authorisation of the unified environmental use permit should start after the completion of environmental impact assessment.

Act LVII of 1995 on Water Management

The Act applies to groundwater and their natural aquifers too, to the facilities and activities, which can change or have an impact on the runoff and flow regimes, the quantity and quality of waters or the aquifers of groundwater. According to the Act efforts should be taken for the preservation of the diverse alternatives for water utilisation by regular control of natural waters, by the prevention of water pollution, by the construction and operation of hydraulic facilities serving the conservation or regulation of waters and by preventing, reducing and eliminating damage to water quality, which hinders water use. Groundwater may only be utilised to an extent that the balance between water withdrawal and recharge should be maintained without any adverse effect on the quality of such waters.

The Act lists among the tasks under state responsibilities (relating also to groundwater) the elaboration of the national conception of water management, the implementation of water management tasks which arise from international co-operation, the designation of possible water withdrawal sites as perspective drinking water resources and their preservation in a status appropriate for utilisation, as well as the carrying out of the various regulatory and authorities' tasks.

The Act lists the municipal tasks as well, especially in the field of drinking water supply as far as groundwater is concerned. In connection with tasks of regional significance Regional Water Management Councils should be established.

According to the Act, groundwater and their natural aquifers are owned exclusively by the state, however those who have acquired rights to utilise the water resources, should keep them safe in proportion to the extent of utilisation. In view of the protection of the quantity and quality of available water resources, the water demand may only be met from the water resources not yet committed for water use. In the order to satisfy water demands the following priorities are set by the Act: on the first place are water uses serving as means of life, like drinking water, and water use for public health and emergency responses to disasters; these are followed by the demands of activities serving the population, and livestock watering, fish farming, nature conservation, economic and other uses. When using mineral, thermal and medicinal water resources, the uses by therapeutics and convalescence recreation should be preferred. According to a new regulation of the Act thermal water utilisation for solely energetic purposes may only be developed with re-injection.

If the available quantity of water is reduced for natural or other insurmountable reasons, water use may be restricted without compensation, except that for subsistence, in the order mentioned above.

A water license should be required for carrying out operations on waters or for the construction, reconstruction and removal of hydraulic facilities (establishing permit) furthermore for their use and operation (operating permit) (see: Government Decree No. 72/1996. (V.22.) Korm. and Decree No. 18/1996. (VI.13.) KHVM of the Minister of Transport Communication and Water Management). In the field of groundwater this refers mainly to production wells.

According to the most recent regulations in accordance with the EU-regulations water licenses are granted for a definite period.

The user is obliged to pay a water resources charge for the amount of water committed in the permit or used without permit. In 2005 the Act was amplified by several new sections specifying the obligation of paying a water resources fee, the amount of the fee, exemptions form paying the fee, the ways of effecting the payment, claims for repayment and the obligation of making a declaratory statement [see also Decree No. 11/1999. (III. 11.) KHVM of the Minister of Transport, Communication and Water Management, and Decree No. 43/1999. (XII. 26.) KHVM of the Minister of Transport, Communication and Water Management].

Waters serving or designated for drinking water supply and for utilisation as mineral and medicinal water should be kept strictly protected and safeguarded, by developing and maintaining protective blocks and protection areas of water withdrawal sites as specified in separate pieces of legislation [see: Government Decree No. 123/1997. (VII. 18.) Korm]. In order to protect perspective drinking water resources and water resources already committed with preliminary water licenses the water authority may order the restriction of ownership and use in accordance with a separate piece of legislation.

Government Decree No. 72/1996. (V. 22.) Korm. on the implementation of authority powers in water management

The Decree, authorised by the Water Act regulates the powers of the organs of water administration (the competent environmental, nature protection and water inspectorate on 1st instance, the National Environmental, Nature protection and Water Inspectorate as 2nd instance authority), of the municipal notaries and the implementation of authority powers in water management. The water permit required for operations on water and for the construction of hydraulic facilities (in connection with groundwater: wells and the captures of springs) should be acquired by the owner.

> *Prior to the implementation process the owner or the consultant commissioned by the former may apply for the **planning water license (preliminary permit)** in which the variants most suitable for the implementation of the water management objective and their preconditions, the possible site and technology of the acquisition and utilisation of water and the disposal of used water, the quantity of water exploitable together with its mean and extreme values furthermore the limit values of the amount and quality of used water to be disposed, and the environmental and nature conservation requirements for the planning, construction and operation should be fixed.*

Permit for construction **(construction water permit)** relating to water uses may be granted only if simultaneously the collection, treatment and disposal of wastewater produced as a consequence of the utilisation is solved in compliance with the environmental rules.

An **operating water permit** is required for the execution of water use and the operation of hydraulic facilities. It should prescribe among others the conditions of operation, the rights and obligations in connection with it, the self-control and the date of expiry. For public hydraulic facilities the permit prescribes the elaboration and execution of the

Rules of Operation. In the case of hydraulic facilities on groundwater (mainly wells) a documentation defined by a separate piece of legislation should be attached (Hydrogeological Report).

Decree No. 18/1996. (VI. 13.) KHVM of the Minister of Transport, Communication and Water Management on the application form and its annexes to be submitted for granting the water permit

The regulation defines the requirements on the contents of the application for the aforementioned preliminary, construction and operating water permit and of the documents to be submitted for licensing. In the field of groundwater management the Decree gives regulations on the acquisition of water, on the facilities of water abstraction (wells, springs), protective blocks and protection areas, in the latter cases to be interpreted together with the Government Decree No. 123/1997. (VII. 18.) Korm.

Government Decree No. 123/1997. (VII. 18.) Korm. on the protection of the actual and perspective sources and the engineering facilities of drinking water supply

The scope of the Decree covers the sources of water used to meet drinking water demands of the population, the utilisation of mineral- and medicinal waters, regardless whether actually exploited, committed or designated for future use, further the facilities serving the treatment, storage and distribution of water for such uses serving at least 50 persons on a daily average. These sources and facilities of water supply should be provided with special protection and therefore protective blocks, protection areas should be designated around them.

> *The source of water supply (resources developed for water withdrawal) is defined by the Water Act as it follows: it is "an area or subsurface part of the space, which is used or designated for utilisation by intake works, as well as the water available for withdrawal there from, together with the existing and planned water taking facilities"*

In case of groundwater resources the protective block and the protection area should be divided into inner, outer and hydrogeological protection zones. The dimensioning is based on the travel times calculated from the groundwater flow velocity (travel time: the time necessary for the pollutant getting into groundwater, or the water particle carrying it to reach the abstraction site):

- *20 days travel time (or a radius of 10 m as a minimum) belongs to the inner protection zone (assuring technical protection),*
- *half a year (or a radius of 100 m as a minimum) belongs to the outer protection zone,*
- *part "A" of the hydrological protection zone is defined by 5 years travel time,*
- *part "B" is defined by 50 years,*
- *the outer bor"der of part "C" is coinciding with the border of the whole recharge area (being designated exceptionally only).*

The Decree prescribes various restrictions in the various zones on the potential pollution sources and polluting activities:

- *in the inner zone practically any activity not part of the operation of the facilities is prohibited,*
- *the outer zone keeps also the degradable contaminants away,*
- *the hydrogeological protection zones protect against the substances non-degradable within the travel time.*

Restrictions are more stringent for newly launched activities, running activities may be allowed under some stipulations. The Decree prescribes several conditional terms for both cases, depending on the outcomes of the environmental audit. The restrictions are relating to construction, recreation, industry, transport, mining and drilling activities. (In part "B" of the hydrogeological protection zone complete prohibition relates only to activities with strongly toxic or radioactive substances, to the infiltration of industrial wastewaters and to the release of transported wastewaters. In zone "A" of more limited extension and further on towards the abstraction facilities one can find more and more severe restrictions.)

Table 1

Multipliers to the water resources fee

Type of water		Character of water uses						
Groundwater		medicinal purpose	public purpose	Economic purpose				
				drinking water	irrigation	animal farms	bath	other
medicinal	registered	1,0	5,0	5,0			5,0	10,0
thermal water	>or= 30°C	1,0	1,0	3,0			3,0	7,5
karstic water	Class I		1,2	3,0		4,0	3,0	6,0
	Class II		1,0	2,0		3,0	2,0	5,0
	Class III		0,5	1,0		2,0	1,0	4,0
deep groundwater	Class I		1,0	3,0	4,0	3,5	3,0	5,0
	Class II		0,8	2,0	3,0	2,0	2,0	4,0
	Class III		0,5	1,0	2,0	1,0	1,0	2,0
bank-filtered water	Class I		1,0	3,0	3,5	3,5	3,0	4,0
	Class II		0,8	2,0	2,0	2,0	2,0	3,0
	Class III		0,5	1,0	1,0	1,0	1,0	1,0
shallow groundwater	Class I		1,0	1,5	2,0	1,5	1,5	3,0
	Class II		0,7	1,1	1,5	1,1	1,1	2,0
	Class III		0,5	1,0	1,0	1,0	1,0	1,5

Class I	Water of quality not exceeding the tolerable levels of the standard
Class II	Water of quality exceeding the tolerable levels of the standard, which may be purificated to drinking water quality with standard treatment technology economically
Class III	Water of quality exceeding the tolerable levels of the standard, which cannot be purificated to drinking water quality with standard economical treatment technology economically

The Decree contains also the rules of procedure on the documentation of safeguarding a particular drinking water resource, on the designation of protection zones and on keeping drinking water resources safe.

Joint Instruction No. 8001/2000 (Kö. Vi. Ért. 5) KöViM-KöM of the Minister of Transport, Communication and Water Management, and of the Minister of Environmental Protection on the perspective sources of drinking water supply

Authorized by the Water Act and with respect to the Government Decree No. 123/1997. (VII. 18.) Korm. the ministers declared the potential abstraction areas listed in the Annex of the Instruction as perspective sources of drinking water supply.

Decree No. 43/1999. (XII. 26) KHVM of the Minister of Transport, Communication and Water Management on the calculation of water resources charge

The Decree, referring to the Water Act, obliges also the users of groundwater to pay the water resources charge. The basic charge, defined by the Act on the State Budget yearly, is multiplied by factors depending on the particular water use, the character of the water resource and on the water management situation of the appropriate region. The multiplier factors concerning groundwater-uses can be found in **Table 1**.

Government Decree No. 201/2001. (X. 25.) Korm. on drinking water quality requirements and control applies to waters originating form public water supplies providing more than 10 m^3 a day or serving more than 50 persons and the water is utilised in a public establishment or for the production of food for commercial purposes. The limit values of

the most important components for drinking water are listed in **Annex 3**.

Ministerial Decree No. 21/2002. (IV. 25.) KöViM on the operation of public water supplies regulates among others the tasks of the operators of public water supplies in connection with the use of drinking water resources. The Decree specifies the components to be measured in normal state, in the course of the regular routine investigations and the control investigations, the frequency of measurements and the terms of data reporting. The Decree states the terms of extraordinary investigations to ensure the safety of drinking water quality if contamination is or is likely to be in the recharge area.

Government Decree No. 132/1997. (VII. 24.) Korm. on the tasks in connection with the elimination of accidental water pollution

The Decree regulating the activity serving the prevention, averting or moderating the damages resulting from the excessive contamination of water due to unforeseeable events or unknown reasons relates also to groundwater (especially the accidental pollutions of shallow groundwater are belonging to this item).

Act LIII of 1996 on nature conservation

The Act relates also to groundwater: among others each spring and sinkhole is under protection.

> *For the purposes of the Act **spring** means any natural outflow of water from earth provided that its discharge exceeds 5 l/min, even if it gets temporarily dry. **Sinkhole** means any cleft in karsts which conducts a permanent or temporary watercourse underground.*

In the framework of the general protection of natural geological values the Act prohibits the pollution or unlawful modification of the status of karstic rocks or the karstic water below the uncovered karstic surfaces. Through this and with the protection of habitats, landscapes, lakes, watercourses, swamps, geological formations and caves the Act serves also the protection of groundwater indirectly.

Instruction of KvVM No. 8002/2005 (MK 138.) on the list of open karstic areas in peripheries contains the lot numbers of the grounds being in connection with open karsts. The list is an informative one and does not influence the protection and restrictions coming from other pieces of legislation. It aims at publishing those areas where, upon the Art. 19. (3) of the Act on nature conservation, the pollution or any change of the state of the karstic water on the surface of the open karst.

Decree No. 74/1999. (XII. 25.) EüM of the Minister of Public Health on the natural curative factors

The scope of the Decree extends to the curative activities utilising natural medicinal factors, to medicinal baths, climatic health institutions, and to those producing and trading natural mineral water, medicinal water and curative mud.

From the point of view of groundwater the process of qualification of mineral waters and medicinal waters is important.

> *For the purpose of the Decree **medicinal water** is natural mineral water of proved curative effect. The curative effect should be proved by medical tests. The medicinal water should comply with the requirements of mineral water in each case.*

The Decree differentiates between external (as bathwater) and internal use (for the purpose of drinking, bottling, inhalation). The Decree regulates also the process and requirements of the registration of health resorts, medicinal baths or curative mud.

Joint Decree No. 65/2004. (IV. 27.) FVM – EszCsM – GKM relating to the bottling and marketing of natural mineral water, spring water, drinking water, drinking waters with enriched mineral content and flavoured water in harmony with the EU Directive 80/777/EEC and the amending EU Directive 96/70/EC

According to the Decree natural mineral water

- originates from a protected aquifer,
- is naturally unpolluted, has favourable qualities due to its mineral and trace element content and other components,
- its composition and temperature are almost constant,
- when being bottled the quantity of the components listed in the annex of the Decree does not exceed the permissible limit value,
- complies with microbiological requirements.

The Decree does neither specify the minimum total dissolved matter content, nor the necessary concentration of any of the components. Based on the Decree almost each groundwater abstraction in Hungary may be qualified – if so required – as natural mineral water.

Act XLVIII of 1993 on mining

Almost all kinds of mining activity may affect groundwater. The Act declares that in this respect the environmental and water management regulations are decisive:

- *if the exploitation of geothermal energy requires the abstraction of groundwater, the Mining Authority takes part in the process of granting the water permit as expert authority,*
- *the technical plan of the mining activity should be elaborated so as to assure the possible prevention or reduction of environmental-natural damages (in certain cases damages appear in groundwater or they are transmitted by them),*
- *the mining company may use the water exploited in order to ensure the security of the mining activity for its operational purposes. For the utilisation of the exploited water the rules of environmental protection and water management are definitive,*
- *the re-injection of fluids brought to the surface by the mining company requires environmental impact assessment and should have the environmental license prior to the application for the water permit,*
- *the Mining Authority participates in the water licensing process in connection with the bringing the groundwater to the surface,*
- *as far as closing up of the mines is concerned, the Act specifies that the underground spaces should be abandoned in a state which is not endangering the environment or the ground surface (this is important particularly with a view to the protection of groundwater).*

Government Decree No. 203/1998. (XII. 19.) Korm. on the execution of the Act XLVIII of 1993 on mining

The Decree specifies that the technical description of the mining site should define the impacts on groundwater.

In the case of all mining activities the preliminary investigation set out in the Gov. Decree No. 314/2005. (XII. 25.) Korm has to be carried out to determine if the mining activity concerned requires environmental impact assessment. The activity may be started only after the environmental permit, or the unified environmental use permit has been granted based on the investigations specified in the relevant piece of legislation.

The existence of one of the aforementioned permits is a precondition to the technical plan of mining operations. The technical plan of mining operations has to deal with the impacts of mining activity on the environment, with the measures on the prevention and reduction of harmful environmental impacts, the monitoring of the impacts and with the way of establishing and operating the monitoring sites. This relates also to the protection of groundwater.

Government Decree No. 239/2000. (XII. 23.) Korm. on the rights and obligations with reference to the utilisation of gravel- and sand-pit pools

*The definition of **pit-pool** in the Decree is as follows: stagnant body of water developed from groundwater resources as a result of surface- or underground mining by removal of the covering layer, which remains after stopping the mining activity and the bed of which is a depression excavated in the course of mining activities.*

As provided by the Decree a water permit is required to the maintenance, use, and utilisation of the pool as a water resource. The pollution of the water of the pools is prohibited, especially their use as recipient of waste water, as well as any use endangering the quality of their water because of the close contact with groundwater resources.

Government Decree No. 27/2006. (II. 7.) Korm. on the protection of waters against pollution caused by nitrates of agricultural sources

The Decree replaced the Gov. Decree 49/2001. (IV. 3.) of the same title, so that regulations on data reporting (Article 9 and **Annex 3**), as well as the provisions on the good agricultural practice (**Annex 1**) remained provisionally in force. The Decree designates the areas vulnerable against nitrate pollution in terms of the protection of both surface and groundwater. There has been no change in the designation of vulnerable zones in terms of surface waters: the catchment areas of the big lakes (Lake Fertő, Lake Balaton and Lake Velence), further the catchment areas of every drinking water storage reservoir and a 300 m wide zone around the shoreline of pit pools are considered vulnerable against nitrate pollution.

The aspects of designation in terms of groundwater did not change, either. However 10% of the designated areas were modified based on new data (67 settlement were removed and 320 settlements were added to the list). The Decree includes the list of settlements in nitrate vulnerable areas. Vulnerable areas, as well as the settlements located in such areas are also available on the home page of the Ministry of Environment. In addition to the above areas all residential areas of settlements, where agricultural activity (e. g. animal breeding) is permitted and the nitrate content of groundwater exceeds 50 mg/l should be considered vulnerable.

In the nitrate-vulnerable areas the requirements of good agricultural practice should be fulfilled as regulated in the Annex of the Decree (e. g. insulated manure storage vessels of sufficient capacity, periods when land application of fertilizers are prohibited, limitation of the land application of fertilizers). Those performing agricultural activities should keep a record on the amount of manure coming into being and stored in the animal farm and on its land application. Based upon the record the data should be reported to the soil protection authority.

The nitrate content of waters should be surveyed every four years and based upon the results a proposal should be submitted to the government on the possibly necessary amendments both of the designation of nitrate-vulnerable areas and of the rules of good agricultural practice. The action program, the obligatory rules of correct agricultural practice and the provisions on data recording and reporting will be published in a ministerial decree in 2006 as expected.

Government Decree No. 50/2001. (IV. 3.) Korm. on the rules of use and handling of waste waters and sludge in agriculture

The objective of the Decree is to regulate the transport of treated municipal wastewater and sludge to the agricultural areas, the agricultural usability of liquid municipal wastes included.

The provisions of the Decree are based among others – on the presumption that complying with the pressure limit values specified for soil would not result in the contamination of groundwater. The requirements on soils are in compliance with the pollution limit value (B) set for the geological formations in the Joint Decree No. 10/2000. (VI. 2.) KöM-EüM-FVM-KHVM.

The Decree defines, according to **the Act LV of 1994 on the protection of arable land,** the performance of the activity subject to a permit. It prescribes among others those soil and shallow groundwater investigations, which are necessary for the preparation of pedological expert statements and for the preparation of the documentations to be handed in to expert authorities. The Decree complies with the Gov. Decree No. 27/2006. (II. 7.) Korm. too.

The total annual amount of nitrogen transported with the wastewater and sludge to the farmland may not exceed the 170 kg/ha value, organic manure included.

If for any reason the level of hazardous substances in the soil or groundwater exceeds the tolerable level (the pollution limit value (B)) then the situation should be investigated according to the Government Decree No. 219/2004. (VII. 21.) Korm., and remediation should be commenced.

The **Act LXXXIX of 2003 on the fee on environmental pressure** applies to air, water and soil pressure fees. The aim of the introduction of the soil pressure fee (TTD) is to reduce the discharge of pollutants into groundwater in settlements by using economic regulation tools. One characteristic of TTD is that it only affects a small number of people putting pressure on soil, as it only applies to those who have the possibility to be connected to the public sewage system, but do not make use of it. The experience that a part of the population does not want to use public utilities (sewage systems, waste water treatment plants) built with significant subsidies from the state budget, because they don't want to pay canal tolls was one of the motivations of the legislators.

Therefore the aim of TTD is to create a situation, in which a solution less favourable for the environment, i.e. not making use of the available sewage system, should not be more profitable for people.

Local governments may spend revenues from TTD only on soil protection, and the quantitative and qualitative protection of groundwater, in particular on the construction of sewage systems, on waste water treatment, the protection of groundwater resources, the remediation of permanent environmental damages, the prevention of pollution by (potential) pollution sources, the subsequent establishment of technical protection, and the development and operation of the settlement monitoring.

Exemption from the TTD is given to those, who apply an own waste water disposal or waste water treatment small facility in a way so as the chemical analyses of shallow groundwater taken from the monitoring well constructed by the user of environment and appropriate for the monitoring of shallow groundwater show no deterioration in quality.

The amount of TTD depends among others on the sensitivity factor of areas listed in the Annex of the **Ministerial Decree No. 27/2004. (XII. 25.) KvVM** on the classification of settlements located in sensitive areas in terms of groundwater status.

REVIEW OF INFORMATION, GROUNDWATER DATABASES AND THEIR ACCESSIBILITY

The major part of information on groundwater is the result of the hydrometric activity. **Decree No. 22/1998. (XI. 16) KHVM of the Minister of Transport, Communication and Water on the hydrographical activities of the water** organisation regulates the central and regional tasks relating to the exploration, assessment, evaluation and forecast of quantity- and quality characteristics of surface- and groundwater. Among others it deals with the operation of the hydrographical observation network, with the data reporting of water users and other organisations, the periodic state-assessments, further with the transfer, storage and communication of data.

Most of the information on groundwater is contained by the hydrogeological reports compiled on each well and by the National Cadastre of Wells, where data extracted from these reports are recorded.

One can find the following data in the **hydrogeological reports**:

- *serial number in the Cadastre (numbered continuously within each settlement, making difference between the inner and outer areas),*
- *locality, county, the exact address,*
- *purpose of water abstraction, no. of construction permit, registration number, name of the competent District Water Authority,*
- *no. of the relevant cartographic sheet, national cartographic coordinates (EOV),*
- *depth of the cased section of the well, maximum depth of the borehole,*
- *drilling technology, type and no. of drilling rig,*
- *detailed description of the penetrated layers (from m to m) on the basis of sampling and geophysical log,*
- *casing and screening of the completed well (from m to m, diameter, the material of casing and screens),*
- *temperature of abstracted water, bottomhole temperature,*
- *data of other operations,*
- *attachments (general 1:25 000 and detailed map of the site, flow-curve, flow-test, recovery test, gas/water proportion, water chemistry, geological and technical log of the well, diagrams of geophysical tests).*

The **published cadastre** prepared yearly from the data of the hydrogeological reports contains the following:

- *locality, no. in the Cadastre, name of the well, the year of completion, registration number,*
- *altitude of the site above sea level, national coordinates (EOV),*
- *depth, casing (diameter, depth), screen (depth, type),*
- *age and type of the aquifer,*
- *depth to static level and to drawdown, yield, specific yield,*
- *temperature of water at the head and at the bottom, depth of measuring,*
- *methane content,*
- *water chemistry (Na+K, Ca, Mg, Fe, Mn, As, NH_4, NO_2, NO_3, Cl, SO_4, total salt content, pH, total hardness, alkalinity, specific conductivity, O_2 consumption.*

The digital data volume of the **Groundwater Resources Atlas** linked to GIS is refreshed yearly. It contains the data of the withdrawals of the operating, monitoring and reserve wells as they follow:

- *data of production facilities at the date of completion and the volume produced in the particular year,*
- *important basic data of the above facilities as grouped in the water licenses and the exploitable volume stated in the license.*

Data of operation (static and operational levels of wells and springs, yield, data of production, results of water abstraction and quality analyses) are forwarded by the operators of public water facilities and other operators designated by the competent environmental and water directorates to the regional and central data archives.

The following basic networks are operated for the countrywide monitoring of the quantity and quality changes of groundwater:

The **basic network for shallow and deep groundwater level monitoring** is operated by the state water- and geological organizations since a long time. The network for shallow groundwater level observation has been developed since the 30s and extends to the plain areas and comprises 1596 observation wells. The basic network for the monitoring of karstic water levels comprises 245 stations at the time being, and it has been developed since the 50s mainly in the Transdanubian Range mostly linked to the mining activities. The basic network for deep groundwater level monitoring has been developed since the middle of the 70s utilising abandoned production wells for the most part; 378 such wells are being observed at present. Also the springs that are not connected to water supply systems are observed by the state water organization. The basic monitoring network of springs is recording the yield of 51 springs at the time being. The proportion of automatic recorders is continuously increasing in the networks.

The **Basic Groundwater Quality Network** has been developed since the mid-80s. Due to the lack of financial resources it includes mainly water supply well in operation and some springs. 1 to 12 samples are taken per year, and the results are transmitted to the central archives. This network is based primarily on a part of water quality data originating from the collection of operational data (see above), therefore it does not comply yet with the requirements of a national basic water quality monitoring network.

Recognizing this the establishment of environmental monitoring networks aiming at the development of a monitoring system has started in 1996 definitely for the purpose of the observation of the most sensitive shallow and confined groundwater resources. (Danube-Tisza Interfluvial, national network in agricultural areas, especially in the vicinity of TIM (Soil Information Monitoring) points, settlement monitoring, accidental monitoring along rivers, springs).

One objective of the PHARE project being finished by March 2006 was to further develop the monitoring networks by including new sites in agricultural areas, settlements and springs so as to meet the requirements of the **Ministerial Decree 30/2004. (XII. 30.) KvVM**.

The information listed above are available in the **Central Hydrographical Archives** (Budapest, IX. Kvassay Jenő út 1. Building K 2nd floor) operated by VITUKI Kht. Water Management Directorate, (open: 09 h –14 h on workdays; free access to the data allowed, copy of paper sheets may be claimed on cost price).

The 1:25 000 scale maps of the National Cadastre of Wells displaying the well sites can be found also here. **The Hydrographical Yearbook** published by VITUKI Kht. every year contains the data of the basic hydrographical network. Data of groundwater uses of the year and groundwater levels measured in a network operated by the Geological Institute of Hungary can be found in a CD attached to the Yearbook.

In the Central Hydrographical Archives the data of the Basic Hydrographical Network are available in digital form as well. The digital data volume of the Well Cadastre should yet be put into the proper order. The GIS materials of the **Groundwater Resources Atlas** readable in ArcView format, usable for those possessing the proper hardware, software and entitlement to use the OTAB master-map, and the data-volume of the year relating to the objects or groups of objects may be claimed as well.

To these are connected the sensitivity maps of the relevant areas and settlements elaborated according to Annex 2/1 of the Government Decree No. 219/2004. (VII. 21.). The set of sensitivity maps and the list of settlements can be observed on the homepage of the Ministry of Environment (**www.kvvm.hu**). The maps of scale 1:100 000 in Arc-View format displaying the sensitivity of the areas and settlements can be found on CD at the environmental inspectorates or may be claimed at VITUKI Kht.

The development of the **Environmental Registration System for Groundwater and the Geological Medium (FAVI)** specified by Gov. Decree No. 219/2004. (VII. 21.) Korm. is in progress. FAVI contains among others information on the status of groundwater, data on their state-requirements, on the hazardous or polluting activities and on the connected environmental measures as well.

To enable the proper operation of FAVI information on activities posing a risk or pressure on groundwater should be submitted to the competent environmental inspectorate using various data-sheets.

As far as groundwaters are concerned, the information on the geological formations available at the **Hungarian Geological Survey** (Magyar Geológiai Szolgálat), the **Geological Institute of Hungary** (Magyar Állami Földtani Intézet – MÁFI) and at the **Eötvös Lórand Geophysical Institute of Hungary** (Eötvös Lorand Geofizikai Intezet) are of definitive importance. Especially the surface geological maps, the map-series showing the geological formations of the upper 10 m, those dealing with the plain and hilly regions, the various thematic series (regional sensitivity, agrogeological, hydrogeological ones, etc.) and the data of the observation network mentioned earlier should be stressed.

Information on groundwater are simultaneously geological data as well. **The Joint Decree No. 4/1997. (III. 17.) IKIM-KTM-KHVM of the Ministers of Commerce and Industry, Environmental Protection and Regional Development, and the Transport, Communication and Water Management on the groups and communication of geological data to be submitted to the Hungarian Geological Survey** applies to organisations and mining companies carrying out geological explorations and to the geological data obtained in the course of their activities, hydrogeological explorations included.

The topsoil influences the recharge and infiltration as well. Data stored at the **Research Institute for Soil Sciences and Agricultural Chemistry of the Hungarian Academy of Sciences (MTA TAKI)** and at the **Plant Protection and Soil Conservation Services** are covering not only the composition of soils but also the pressure of diffuse pollution from agricultural sources, and land use. From this point of view the **TIM (Soil Information Monitoring)** is very important. MTA TAKI was who developed the **Agro-topographic Database (AGROTOPO)** containing homogeneous agro-ecological units, covering the whole area of the country at a scale 1:100 000, further the **Hungarian Digital Database on Soil Sciences and Ground-relief (HunSOTER)**, the latter as part of a global database supervised by UNEP. Beyond these the Institute possesses further extended databases containing map-series and GIS-based sets of information.

The **Johann Bela National Centre of Epidemiology** (Johann Bela Országos Epidemiológiai Központ) is dealing with the investigation of waters from the aspect of public health. A number of quality and bacteriological data originating from the **National Public Health and Medical Officer Service (Állami Népegészségügyi és Tisztiorvosi Szolgálat – ÁNTSZ)** are stored here.

Local information on groundwater are available also at the water supply companies, at public baths and at mining companies (to a decreasing extent).

The processing of archive groundwater-information and its supplementation through expedition-like surveys have become a large-scale task of the state to be implemented in the frame of the monitoring objectives in the surveillance phase of the EU Water Framework Directive. Supplementary exploration with boreholes is required to obtain data on the quality of the near-surface water resources, in other cases the numerous observation- and production wells give the possibility of state assessment of the various water bodies.

The Ministry for Environment and Water issued several publications on groundwater in the recent years (**Annex 4**).

ANNEXES

1. Major Hungarian legislation concerning groundwater protection
- 1/a Definitions of limit values in the Gov. Decree No. 219/2004. (VII. 21.) Korm.
- 1/b List of pollutants (Annex 1 to the Gov. Decree No. 219/2004. (VII. 21.) Korm.)
- 1/c Classification of areas sensitive in terms of groundwater status (Annex 2 to the Gov. Decree No. 219/2004. (VII. 21.) Korm.)
- 1/d Paragraph (1) of Article 5 of Gov. Decree 27/2006. (II.7.) Korm. on the protection of waters again pollution caused by nitrates form agricultural sources

2. Activities having significant effect on groundwaters or on the protection zones of water resources listed in the Annexes of the Government Decree No. 314/2005. (XII. 25.) Korm. on environmental impact assessment and the unified environmental use permits

3. The comparison of limit values in the various regulations

4. KvVM Publications in connection with groundwater

Annex 1

Major Hungarian legislation concerning groundwater

Acts

- Act XLVIII of 1993 on Mining Activities
- Act I of 1994 on the publication of the Treaty between the Member States of the European Union and the Republic of Hungary, concerning the accession of the Republic of Hungary to the European Union signed on December 16, 1991 in Brussels
- Act LV of 1994 on Arable Land
- Act LIII of 1995 on the General Rules of Environmental Protection
- Act LVII of 1995 on Water Management
- Act LIII of 1996 on Nature Conservation in Hungary
- Act LIV of 1996 on the Forests and the Protection thereof
- Act XLIII of 2000 on Waste Management
- Act LXXXIX of 2003 on the Environmental Pressure Charge

Government Decrees

- Government Decree No. 38/1995 (IV. 5.) Korm. on the Public Drinking Water Supply and Public Sewerage
- Government Decree No. 72/1996 (V. 22.) Korm. on implementation of authority powers in water management
- Government Decree No. 123/1997 (VII. 18.) Korm. on the protection of the actual and perspective sources and the engineering facilities of drinking water supply
- Government Decree No. 132/1997. (VII. 24.) Korm. on the tasks in connection with the elimination of accidental water pollution
- Government Decree No.203/1998. (XII. 19.) Korm. on the execution of the Act XLVIII of 1993 on mining activities
- Government Decree No. 74/2000. (V. 31.) Korm. on the announcement of the Convention on the Protection and Sustainable Use of the Danube River done in Sofia on the 29th June 1994
- Government Decree No. 239/2000 (XII. 23.) Korm. on the rights and obligations linked to the utilisation of pit pools.
- Government Decree No. 50/2001 (IV. 3.) Korm. on the rules of use and handling of waste waters and sludge in agriculture
- Government Decree No. 201/2001 (X. 25.) Korm. on the quality requirements of drinking water and the order of supervision thereof
- Government Decree No. 219/2004. (VII. 21.) Korm. on the protection of groundwater
- Government Decree No. 220/2004. (VII. 21.) Korm. on the protection of surface water quality
- Government Decree No. 221/2004. (VII. 21.) Korm. on certain rules of river basin management
- The Government Decree No. 314/2005. (XII. 25.) Korm. on environmental impact assessment and the unified environmental use permits
- Government Decree No. 27/2006. (II. 7.) Korm. on the protection of waters against pollution caused by nitrates of agricultural sources

Decrees of ministers

- Decree No. 18/1992 (VII. 4.) KHVM of the Minister of Transport, Communication and Water Management on the requirements of the operation of public water facilities
- Decree No. 18/1996 (VI. 13.) KHVM of the Minister of Transport, Communication and Water Management on the application for a water permit and the annexes thereof
- Joint Decree No. 4/1997. (III. 5) IKIM-KTM-KHVM of the Minister of Industry and Commerce, Minister of Environmental Protection and Regional Development and the Minister of Transport, Communication and Water Management on the set of data originating from geological explorations to be transmitted to the Hungarian Geological Service, and on the order of communication thereof
- Decree No. 29/1997 /IV. 30) FM of the Minister of Agriculture on the execution of the Act on the Protection of Forests
- Decree No. 22/1998. (XI. 6.) KHVM of the Minister of Transport, Communication and Water Management on the hydrographical activities of the water organisation
- Decree No. 11/1999 (III. 11.) KHVM of the Minister of Transport, Communication and Water Management on the appropriation of the Water Earmarked Financial Facility
- Decree No. 43/1999 (XII. 26.) KHVM of the Minister of Transport, Communication and Water Management on the calculation of water resources charge
- Decree No. 74/1999 (XII. 25.) EüM of the Minister of Public Health on the natural curative factors
- Joint Decree No. 10/2000 (VI. 2.) KöM-EüM-FVM-KHVM of the Minister of Environment, Minister of Public Health, Minister of Agriculture and Regional Development and the Minister of Transport, Communication and Water Management on the limit values required to the quality protection of groundwater and the geological media
- Decree 21/2002. (IV. 25.) KöViM of the Minister of Transport and Water Management on the operation of public water supplies
- Decree 27/2004. (XII. 25.) KvVM of the Minister of Environment and Water on classification of settlements located in sensitive areas in terms of groundwater status
- Decree 28/2004. (XII. 25.) KvVM of the Minister of Environment and Water on the limit values of water pollutants and certain rules of the application thereof
- Decree 30/2004. (XII. 30.) KvVM of the Minister of Environment and Water on rules for the investigation of groundwaters
- Joint Decree 65/2004. (IV. 24.) FVM-EszCsM-GKM on the rules of bottling and marketing of natural mineral water, spring water, drinking water, drinking waters with enriched mineral content and flavoured water
- Decree 14/2005. (III. 28.) KvVM of the Minister of Environment and Water on the rules of screening investigations to be carried out in the course of remedial site investigation
- Decree 27/2005. (XII. 6.) KvVM of the Minister of Environment and Water on the detailed rules of the control of used and waste water emissions

Instructions, Directives

- Joint Instruction No. 8001/2000 (Kö. Vi. Ért. 5.) KöViM-KöM of the Minister of Transport and Water Management and the Minister of Environment on the perspective sources of drinking water supply
- Instruction No. 8001/2002 (K. Ért. 2.) KöM of the Minister of Environment on the modification of the Instruction No. 8001/2002 (K. Ért. 6.) publishing the data-sheet specified by the Government Decree No. 33/2000 (III. 17.) Korm.
- Instruction No. 8002/2005 (MK 138.) KvVM of the Minister of Environment and Water on the register of open karsts in external areas
- Instruction No. 8/1970 (V. É. 6.) OVH of the National Water Authority on the publication of the operational regulations of geothermal wells (geothermal installations)
- Directive No. 2/1971 (V. 18.) OVH of the National Water Authority on the obligatory periodical instrument testing and maintenance of geothermal wells

Annex 1/a

Definitions of limit values in the Gov. Decree No. 219/2004. (VII. 21.) Korm

Background concentration (A) is a representative value which expresses the general concentration of particular substances in groundwater or soil under natural or close to natural conditions;

Verified background concentration (A_b) *means* an *actual* concentration of a given substance indicated in groundwater or geological medium determined by measurements and to be applied instead of background concentration (A), that is specific for the given area and resulted from natural conditions or as a consequence of diffuse pressure, pollution or pressure affecting groundwater or geological medium throughout surface water, not associated with the pressure under examination.

Pollution limit value (B) *means the c*oncentration of pollutants or such a level of other indicative parameters of qualitative status established in legislation, or in the absence thereof, in an official ruling, due to which the groundwater and the geological medium is to be qualified as polluted, considering drinking water quality standards and the needs of aquatic ecosystems in the case of groundwater, and the multifunctionality of soils and the sensitivity of groundwater to pollution in the case of geological medium;

Remediation target limit value (D) *means* concentration prescribed in an official ruling to be achieved by remedial actions with the aim of preventing any damage to human health, ecosystems and environmental elements. This value is to be determined on the basis of a complex assessment carried out as part of the remediation procedure, including measurements of pollutant distribution in environmental elements, its behaviour, transport and extent as a well as modelling and site specific quantitative risk assessment carried out with regard to the land uses;

Site specific pollution limit value (E) means pollution limit value defined in an official ruling, to be implemented instead of the pollution limit value (B) in such a specific scenario when the activity had been going on just before Kvt. entered into force, or on any sites, where the verified background concentration (A_b) exceeds the pollution limit value (B). Value "E" – when selecting – should be underpinned by a realistic knowledge of the situation gained by means of quantitative (site specific) risk assessment with regard to the land use and should be neither more stringent than the pollution limit value (B) nor more lenient than the measured actual pollutant concentration value, or the remediation target limit value (D);

Abstraction limit value (M_i) means the total annual volume of water (in m^3/year) that may be withdrawn from a distinct part of body of groundwater with the highest permitted range of declination (by water level draw-down or decreasing of the water pressure level);

Annex 1 to the Governmental Decree 219/2004. (VII. 21.)Korm.

LISTS OF POLLUTANTS

according to the Annex to the Council Directive 80/68/EEC
and Annex VIII of the Directive 2000/60/EC of the European Parliament and the Council

List I contains the individual substances belonging to the families and groups of substances listed below, with the exception of those which are representing low risk with regard to their toxicity, decay and their ability for accumulation in human organism and are not needed to be listed in List I.

Substances which are appropriate to be included in List II with regard to their toxicity, persistence and bio-accumulation characteristics are to be classed in List II.

List I of substances ranked in class K1 with regard to their hazard

1. Organohalogenic compounds and substances which may form such compounds in the aquatic environment
2. Organophosphorus compounds
3. Organotin compounds
4. Substances and preparations, or the breakdown products of such, which have been proved to possess carcinogenic or mutagenic properties or properties which may affect steroidogenic, thyroid, reproduction or other endocrine-related functions in or via the aquatic environment.
5. Mercury and its compounds
6. Cadmium and its compounds
7. Mineral oils and other hydrocarbons, especially persistent hydrocarbons
8. Cyanides.

List II of substances ranked in class K2 with regard to their hazard

List II contains the individual substances and categories of substances belonging to the families and groups of substances listed below which could have a harmful effect on groundwater.

1. Metalloids and metals and their compounds not listed in List I, especially the following metalloids and metals:

1. Zinc
2. Copper
3. Nickel
4. Chrome
5. Lead
6. Selenium
7. Arsenic
8. Antimony
9. Molybdenum
10. Titanium
11. Tin
12. Barium
13. Beryllium
14. Boron
15. Uranium
16. Vanadium
17. Cobalt
18. Thallium
19. Tellurium
20. Silver.

2. Biocides and their derivatives not appearing in List I.

3. Substances which have a deleterious effect on the taste and/or odour of groundwater, and compounds liable to cause the formation of such substances in such water and to render it unfit for human consumption.
4. Toxic or persistent organic compounds of silicon, and substances which may cause the formation of such compounds in water, excluding those which are biologically harmless or are rapidly converted in water into harmless substances
5. Inorganic compounds of phosphorus and elemental phosphorus.
6. Fluorides.
7. Ammonia and nitrites.
8. Substances which contribute to eutrophication (in particular, nitrates and phosphates)
9. Materials in suspension.
10. Substances which have an unfavourable influence on the oxygen balance (and can be measured using parameters such as BOD, COD, etc.).

Annex 2 to the Governmental Decree 219/2004. (VII. 21.) Korm.

Classification of areas sensitive in terms of groundwater status

Aspects of sensitivity classification in the course of investigations:

1. Areas of high sensitivity in terms of groundwater status
   a) internal and external protective zones designated, or previously delineated under a separate piece of legislation, and hydrogeological protective zones designated in a valid water permit decision, for the protection of operating abstractions for the needs of drinking water supply, mineral- and medicinal water uses , as well as for protection of perspective drinking water supply sites, where water resources are maintained for future needs (hereinafter perspective water supply site);
   b) karstic areas where limestone, dolomite, lime- and dolomite marl formations can be found on the land surface or within 10 m below land surface;
   c) the 0.25 km wide zone – from edge of the lake basin – along its shoreline being in possession of the state under the Act LVII of 1995 on water management, and 0.25 -1.00 km wide zone – from edge of the lake basin – along its shoreline for natural beaches registered acc. to a separate piece of legislation ;
   d) areas included in the list of Natural Wild Waters of International Significance, further aquatic habitats under NATURA 2000 as referred to in a separate piece of legislation.

2. Sensitive areas in terms of groundwater status
   a) areas, where the value of long-term average recharge from precipitation exceeds 20 mm/year;
   b) areas not belonging to the class of areas of extremely high sensitivity in terms of groundwater status, where limestone, dolomite, lime- and dolomite marl formations are deposited within 100 m below land surface;
      areas, where the top of the porous main aquifer can be found in the depth of not more than 100 m ;
   c) the 0.25-1.00 km wide zone – from the edge of lake basin – along its shoreline owned by the state under Act LVII of 1995 on water management;
   d) nature conservation areas not mentioned in sub-category 1.d), designated by a separate piece of legislation.

3. Less sensitive areas in terms of groundwater status
   Other areas not included in categories 1 and 2.

Annex 1/d

Paragraph (1) of Section 5 of Gov. Decree 27/2006. (II. 7.) Korm. on the protection of waters again pollution caused by nitrates form agricultural sources

(1) Nitrate vulnerable area should be:

a) with regard to surface waters, the catchment areas of

aa) Lakes Balaton, Velencei and Fertő,

ab) the catchment areas of all the reservoirs serving for drinking water supply ;

b) with regard to groundwater, all

ba) karstic areas where limestone, dolomite, limestone and dolomite marl formations are located on the surface or within 10 m below the surface,

bb) protection zones designated or delimited by specific other legislation for operating and long-term drinking water bases or water extractions for the purpose of mineral and medicinal water use,

bc) karstic areas not included in Items *ba)* and *bb)* where limestone, dolomite, lime and dolomite marl formations are located within 100 m below the surface, except if it is proven by a local test that no nitrogen-containing compound can reach the said formations from the surface within a period of 100 years,

bd) areas where the top of the main porous-aquifer complex is at a depth less than 50 m from the surface;

be) residential areas, except if it is proven that the nitrate content of the groundwater does not exceed the value of 50 mg/l and where animal husbandry activities can be performed according to the community development plan.

c) 300 meter shore zone around pit pools

Annex 2

ACTIVITIES HAVING SIGNIFICANT EFFECT ON GROUNDWATERS OR ON THE PROTECTION ZONES OF WATER RESOURCES

LISTED IN ANNEXES 1 AND 3 OF
THE GOVERNMENT DECREE NO. 314/2005. (XII. 25.) KORM. ON ENVIRONMENTAL IMPACT ASSESSMENT AND THE UNIFIED ENVIRONMENTAL USE PERMITS

Annex 1 of the Gov. Decree 314/2005. (XII. 25.) Korm.

ACTIVITIES SUBJECT TO ENVIRONMENTAL IMPACT ASSESSMENT

34.	**Groundwater use from one abstraction object or object group from 5 million m^3/year** (13.7 thousand m^3 /d)
56.	**Injection into groundwater where the annual volume of water injected is equivalent to or exceeds 3 million m^3/year** (10.0 thousand m^3/d)

Annex 3 of the Gov. Decree 314/2005. (XII. 25.) Korm.

ACTIVITIES IN THE CASE OF WHICH THE NECESSITY OF PERFORMING AN ENVIRONMENTAL IMPACT ASSESSMENT DEPENDS ON THE DECISION OF THE INSPECTORATE

2.	Shift to **intensive agricultural land use/farming** on areas classified as "cultivation ceased" from 50 ha, or in the ***protective zone*** of a groundwater abstraction site, in a protected naturereserve or in its protective zone from ***1 ha***
3.	**Agricultural melioration** – on flat land from 500 ha or – on hilly land from 300 ha, or – in the case when the area to be improved covers a protected nature reserve or its protective zone, or **the protective zone of a groundwater** abstraction site on at least 5 ha **without area limitation**
6.	**Livestock installations** (projects not included in Annex 1) – from 100 standard animals for broilers, – from 200 standard animals for layers, – from 500 standard animals for porkers, – from 150 standard animals for 150 sows, – from 200 standard animals for any other species with liquid manure technology; – **in the protective zone of a groundwater** *abstraction site,* in a protected nature reserve or in its protective zone, on a nature preservation area, **the case of poultry from 10 standard animals other species from 50 standard animals**
13.	Petroleum and natural gas extraction (projects not included in Annex 1); **test drillings** only in a protected nature reserve or in the ***hydrogeological protective zone of a groundwater abstraction sites***

72.	Hydroelectric power stations with an output of 5 MW or more; ***in the protective zone of a groundwater abstraction site*** and in a protected nature reserve **with no size limitation** (if not included in Annex 1)
73.	**Geothermal power stations** with an output of 20 MW or more; ***in the protective zone of a mineral water, medicinal water and drinking water abstraction site*** and in a protected nature reserve **with no size limitation**
80.	Groundwater use (if not included in Annex 1) if the daily abstraction from one object or object group exceeds *1 000 m^3 from shallow groundwater* *500 m^3 from karstic thermal water* *5 000 m^3 from deep groundwater* *2 500 m^3 from cold karstic water* *5 000 m^3 from bank-filtered water* *2 000 m^3 from confined thermal water* *50 m^3 and 33% of the current yield of the spring*
108.	Establishing of a new permanent **flood-control work** in the ***protective zone of a groundwater abstraction*** site or in a protected nature reserve (if not included in Annex 1)
109.	**Waste water treatment** plants with a capacity from 10 000 population equivalent (if not included in Annex 1); ***in the protective zone of a groundwater abstraction site,*** in a protected nature reserve or in its protective zone **with no size limitation**
111.	Independent **sewage sludge disposal sites** from 100 t/year dry matter; in a protected nature reserve or in its protective zone, or ***in the hydrogeological protective zone of a groundwater abstraction site*** **with no size limitation**
112.	**Sites depositing sewage by irrigation** from 50 ha; in a protected nature reserve or in its protective zone, on a nature area, or in ***the "B" hydrogeological protective zone of a groundwater abstraction site*** **with no size limitation**
113.	**Filtration-field drying systems** from 15 ha; in a protected nature reserve or in its protective zone, on a nature area, or in **the *hydrogeological protective zone of a groundwater abstraction site*** **with no size limitation**
114.	**Waste water injection** by underground pipes in a protected nature reserve or in its protective zone, on a nature area, or in the ***protective zone of a groundwater abstraction site***
115.	**Waste water disposal and treatment sites** with a capacity of 100 m^3/day or more; in a protected nature reserve or in its protective zone, on a nature area, or in the ***hydrogeological protective zone of a groundwater abstraction site*** **with no size limitation**
125.	**Golf-course with 18 holes or more** (facilities included) in a nature protection area in the external zone of settlements, or in the ***protective zone of a groundwater abstraction site*** (minigolf excluded) (if not included in Annex 1)
128.	**Deep drillings** with an established drilling facility **from 650 m drilling depth** (unless being part of another activity listed in Annex 1 or 3) in the ***protective zone of a groundwater abstraction site*** or in a protected nature reserve
133.	**Dams and other installations** designed for the holding back or permanent storage of water, where the amount of water held back or stored is at least 1 million m^3 (if not included in Annex 1); in the ***protective zone of a groundwater abstraction***, in a protected nature reserve or on a nature area ***with no size limitation***

134.	**Artificial groundwater recharge/injection schemes** (if not included in Annex 1)
135.	**Local melioraton** on a land not planned to be developed, – from 500 ha plain land, – from 300 ha hilly land, – in ***the protective zone of a groundwater abstraction,*** in a nature protection area in the external zone of settlements, **with no size limitation**
136.	**Fish pond** or a system of fish ponds from 30 ha; in the ***protective zone of a groundwater abstraction***, in a protected nature reserve or in its protective zone, **with no size limitation**
137.	**Standing water and backwater (oxbow) regulation** from 5 ha surface size to be regulated or from 1 km shore length; in **the *protective zone of a groundwater abstraction*,** in a protected nature reserve, **with no size limitation**
138.	**River regulation** or canalisation from^3 km river length; in case of curve cutting or in the ***protective zone of a groundwater abstraction***, in a protected nature reserve, **with no length limitation**
139.	**Regulation of water courses** (except for removal of silt and management of the bank for maintenance and for restoring the original draining capacity) from 1 km current length; in the ***protective zone of a groundwater abstraction*** **from 50 m current length**, in a protected nature reserve with no size limitation

Annex 3

Comparison of limit values according to various regulations

Component	*Unit*	*Gov. Decree. 201/2001. (X. 25.) Korm. on drinking water quality requirements*	*Limit values for natural mineral waters acc. to Annex 1 of the Joint Decree 65/2004. (IV. 27.) FVM-ESzCsM-GKM*	*Registered mineral water acc. to Annex 2 of the Decree 74/1999. (XII. 25.). EüM*	*Groundwater pollution limit value (B) acc. to the Joint Decree 10/2000. (VI. 2.) KöM-EüM-FVM-KHVM*
Antimony	µg/l	5	5		
Arsenic	µg/l	10	10		10
Barium	µg/l		1 000		700
Boron	mg/l	1,0	*		500
Bromate*	µg/l	10	—		
Lithium	mg/l			>5**	
Bromide	mg/l			>5**	
Iodide	mg/l			>1**	
S^{2-}	mg/l			>1**	
Radon	Bq/l			>37**	
Metasilicic acid	mg/l			>50**	
Silver	µg/l	—	—		10
Fluoride	mg/l	1,5	5,0	0,8-1,2***	1,5
Cadmium	µg/l	5,0	3		5
Chrome	µg/l	50	50		50
Lead	µg/l	10	10		10
Tin	µg/l	—	—		10
Mercury	µg/l	1,0	1		1
Nickel	µg/l	20	20		20
Nitrate	mg/l	50	50		25
Nitrite	mg/l	0,5	0,1		
Selenium	µg/l	10	10		5
Zinc	µg/l	—	5000		200
Cyanogen	µg/l		70,0		
Indicator parameters					
Aluminium	µg/l	200	—		
Ammonium	mg/l	0,50			0,5
Chloride	mg/l	250			
Conductivity	µS/cm	2500	—		
pH		6,5-9,5	—		6,5-9,0
Iron	mg/l	0,2	2,0		
Manganese		0,05	0,5		
$COD_{ps/pl}$	mg/l O_2	5			
Sulphate	mg/l	250			250
Phosphate	mg/l	—	—		0,5
Sodium	mg/l	200		<200***	
Hardness	mg/l CaO	50-350			
Minerals	mg/l	—		>1000	
Copper	µg/l	2000	1000		200
Calcium	mg/l			>60***	
Magnesium	mg/l			>20***	
Free CO_2	mg/l			>1000***	

* in oxidative water treatment only;
** in external use;
*** in internal use;
*The determination of the limit value for Boron on Community level is in progress

Organic component		Unit	Gov. Decree. 201/2001. (X. 25.) Korm. on drinking water quality requirements	Groundwater pollution limit value (B) acc. to the Joint Decree 10/2000. (VI. 2.) KöM-EüM-FVM-KHVM
Benzene		µg/l	1,0	1
Benz(a)pyren		µg/l	0,01	0,01
K1		µg/l	3,0	
Epichlorohydrine		µg/l	0,10	
Pesticides without the below:		µg/l	0,10	
distinguished:	aldrin	µg/l	0,03	x 0,03
	dieldrin	µg/l	0,03	x 0,03
	heptachlor	µg/l	0,03	
	heptachlor-epoxide	µg/l	0,03	
Total pesticides		µg/l	0,50	0,5
Polyaromathic hydrocarbons		µg/l	0,10	xx 2
actually:	benzo(b)fluoroanthen			0,02
	benz(k)fluoroanthen			0,02
	benz(ghi)perylene			0,01
	indeno(1,2,3-cd)pyren			0,01
Tetrachloro-ethylene		µg/l	10	10
Trichloro-ethylene				
Total trichloro-methane:		µg/l	50	10
Chloroform				5
Vynil-chloride		µg/l	0,50	0,1
Cis-1,2-dichloro-ethylene		µg/l	50	10
Phenol index		µg/l	20	xxx 20
Oil derivatives		µg/l	50	100

(After I. Horváth and V. Horváth)

x Limit value of total drill

xx Limit value of total PAH without naphthalene

xxx Limit value of total TPH

Statements concerning natural mineral waters and related requirements

acc. to Annex 5 of the Joint Decree 65/2004. (IV. 27.) FVM–ESzCsM–GKM

Low mineral content On the basis of minerals and solid content less than 500 mg/l

Statement:	Requirement:
Very low mineral content	On the basis of minerals and solid content less than 50 mg/l
Rich mineral content	On the basis of minerals and solid content more than 1500 mg/l
Contains bicarbonate	Hydrogen-carbonate content more than 600 mg/l
Contains sulphate	Sulphate content more than 200 mg/l
Contains chloride	Chloride content more tha 200 mg/l
Contains calcium	Calcium content more than 150 mg/l
Contains magnesium	Magnesium content more than 50 mg/l
Contains fluoride	Fluoride content more than 1 mg/l
Contains iron	Iron content more than 1 mg/l
Acidic	Free carbon-dioxide content more than 250 mg/l
Contains sodium	Sodium content more than 200 mg/l
Adequate for a sodium-poor diet	Sodium content less than 20 mg/l

Annex 4

KvVM Publications in on groundwater*

- **DATA ON THE ENVIRONMENTAL STATUS OF HUNGARY (PUBLISHED EVERY YEAR FROM 1996, LAST PUBLISHED IN 2005)**
- **DATA ON THE ENVIRONMENTAL STATUS OF HUNGARY, MINISTRY FOR ENVIRONMENT (English version)**
- **Thermal Water Resources in hungary, their utilisation and protection, guide (2001) (available in Hungarian and English)**
- **EUROPEAN COLLABORATION FOR THE GOOD STATUS OF WATERS – THE CURRENT STATE OF IMPLEMENTATION OF THE WATER FRAMEWORK DIRECTIVE IN HUNGARY AND THE DANUBE RIVER BASIN, 2005**

PUBLICATIONS OF THE NATIONAL ENVIRONMENTAL REMEDIATION PROGRAM

INFORMATIVE PUBLICATIONS

1. Information on the National Environmental Remediation Programme (1997) (available in Hungarian, English and German)
2. Hidden value to be guarded. A piece of legislation [Government Decree No. 33/2000 (III. 17.) Korm.] and what is behind)
3. Groundwaters in Hungary (2002) (available in Hungarian and English)
4. Information on the National Environmental Remediation Program (2002) (English version 2003)
5. Soil Protection. Scientific background of the National Soil Protection Strategy (2005)
6. Prohibited, allowed, obligatory "… about the protection of groundwaters" (Gov. Decree No. 219/2004. (VII. 21.) Korm, 2005)
7. Groundwaters in Hungary II. (2006) (Hungarian, English)

BOOKLETS

1. Liability for the environment, removal of environmental damages by the state (1997)
2. International experience of the remediation of contaminated sites (1997)
3. Brief account of the projects launched in the short term period (1996–97) of the Remediation Programme (1997)
4. Limit values, the system of limit values in the National Environmental Remediation Programme (1998)
5. Groundwater an land use (1998)
6. Methodological principles and peculiarities of preliminary risk assessment procedures in the international practice (2001)
7. Commentary to the sensitivity maps (2001); and Sensitivity maps of Hungary acc. to areas and settlements (available in Hungarian and English, 2001)
8. Methodology of procedure on the legal processes, economical conditions and possible solutions of the municipality remediation sub-program (2002)
9. Sub-program of solid mineral mining – Uranium mining (2003)
10. Commentary on the sensitivity maps [acc. to Annex 2 of the Gov. Decree 219/2004. (VII. 21.) Korm] (2005)

GUIDES

1. Entry of permanent environmental damages into the property register (1997)
2. Monitoring of groundwaters in permanently damaged areas (1998)
3. Guidance on the assessment of land uses and pollutions sources deteriorating groundwaters and the geological medium by remote sensing methods (2001)
4. Application of cost-benefit, cost-effectiveness and value analyses in the course of remediation (2003)
5. Technical inspection of remediation investments (2003)
6. Site inspection and monitoring. Site inspection of contaminated areas and remediation monitoring systems (2003)
7. Methodology of quantitative risk assessment (2004)

HANDBOOKS

1. Use of models on contaminant transport (1998)
2. On the investigation of contaminated soils (1998)
3. Detailed quantitative risk assessment of contaminated areas. Theoretical and practical grounds (2001)
4. Remediation technologies (2001)

* Available at the PR Office of the Ministry of Environment and Water in limited number (1011, Budapest Fő u. 44-50.)

OKKP publications available to download on the homepage: www.kvvm/szakmai/karmentes

REPORTS ON THE IMPLEMENTATION OF THE WATER FRAMEWORK DIRECTIVE
(available on www.euvki.hu)

- REPORT to the European Commission on the implementation of the tasks specified in Art. 3 (8) of the Directive 2000/60/EC of the European Parliament and the Council establishing a framework for Community action in the field of water policy (Water Framework Directive) June 22, 2004

- REPORT on the characterisation of the Hungarian territory in Danube River Basin District, on the environmental impacts of human activity and the economic analysis of water use required by the Directive 2000/60/EC of the European arliament and the Council establishing a framework for Community action in the field of water policy by the deadline of March 22, 2005