Drinking water protection zones in the Adriatic region – state of the art and guidelines for the improvement of the present status

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DRINK ADRIA

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1 INTRODUCTION

The report is prepared in the frame of DRINKADRIA project and its Working Group – Cross–border water resources management - activity 4.4 Water (re)sources protection and cross-border water (re)sources management.

In the DRINKADRIA project proposal it was estimated that protection of drinking water sources recharging from cross-border catchments suffers from lack of regulatory framework, which results in inadequate technical and institutional tools for the assessment and implementation of the protection measures. In the frame of this statement in relation to drinking water protection zones main tasks of the present report can be:

- harmonization of methodology for delineation of water protection areas including measures,

- proposal for improvement of methodologies for delineation of drinking water protection zones,

- proposal for improvement, guidelines and harmonization of regulatory acts for cross-border water resources protection and management.

In the project proposal as an output it is expected to prepare:

- common methodology and guidelines for delineation of drinking water protection zones with proposal of measures for protection,

- joint report on proposal of measures for cross-border drinking water resources protection and management for Adriatic area.

Final beneficiaries (FB) of the DRINKADRIA project are coming from eight independent states around the Adriatic sea; four of them are members of the European Union (Croatia, Greece, Italy, Slovenia) and other four are candidate states at various levels of accession process to the European Union (Albania, Bosnia and Herzegovina, Montenegro, Serbia). For the understanding of common drinking water protection practices in the IPA Adriatic area these are important legal conditions which have consequences in more or less common background for water sources protection. Therefore, in the report existing practices for drinking water protection zones implementation were reviewed, investigated and classified. Based on these results proposal of measures for cross-border water sources protection and management in the IPA Adriatic area were prepared.

The report was prepared by FB5 – University of Ljubljana with the lead author of the report prof. dr. Mihael Brenčič from the Department of Geology. The report was prepared in cooperation with co-workers from FB8, WP4 leaders, and with the help of other FBs. All contributing parties are acknowledging for their help and cooperation.

When countries are listed their order in the list has no meaning; it is intended, where possible to list them in the alphabetical order.

2 DATA COLLECTION AND METHODS

Data for the analysis of drinking water protection zones were collected for all eight participating countries with the help of nearly all participating FBs. Collection of data has been based on reports regarding drinking water protection legislation prepared by each participating country (Annex 1), on the two questionnaires prepared in Excel data sheet (Annex 2 and 3). Moreover, data are based on the direct communication between Lead Author of the present report and contributing authors from FB.

The principles of data collection and analyses of current practices were based on the experiences gained in the similar study between Republic of Slovenia and Republic of Austria where drinking water protection zones were analysed for the purpose of cross border water sources protection (Brenčič et al., 2013). The methodology was presented in the FB's project meeting in Nova Gorica – Slovenia (May 2015) where agreement was reached on implementing similar methodology to the present report. Data and special reports from FBs were collected until the June 2015 and based on the collected data first results of the comparison were presented at Tirana – Albania project meeting (July 2015). Following discussion at the meeting additional questionnaire on surface drinking water sources was prepared and send to FBs responsible for the preparation of the reports (Annex 3). Further results and open questions were discussed in Corfu – Greece (September 2015) and Venice – Italy (March 2016) project meetings.

Data were collected for groundwater as well as for surface water drinking protection zones in two steps, with two questionnaires (questionnaires are given in Annex 2 and 3 to the report). In the first step questionnaire was focused on the general principles of Drinking water protection (DWP). After first processing of the collected data was performed in the second step (after meeting in Tirana - Albania) it was decided to prepare additional questionnaire for Drinking water protection zones (DWPZ) on surface water bodies.

First general questionnaire was focused on general principles and on the implementing procedures for DWPZ design based on the classification of drinking water sources (DWS). It was supposed that DWP legislation in each country is structured in the frame of national legislation as well as at different levels of state's regional organization. Data about umbrella water low and subordinate legislation were collected. Information on the proprietorship of water and water bodies, responsible parties for implementation procedures were collected as well as information on possible indemnities for water usage were gathered. Second part of the questionnaire was dedicated to definition of protection zone and on the

implementing procedures related to their design and protection measures. At this stage of the questionnaire water sources were defined according to the classification valid for each state or at different regional levels.

In the second step the questionnaire for the surface DWS was implemented for the better clarification of protection measures. With the first questionnaire it was in generally determined that groundwater DWPZ are better elaborated and more detailed measures are usually implemented in comparison to surface DWPZ. Therefore, more information on surface water sources and their DWPZ were needed. In the second questionnaire data were collected about different types of surface water DWS, their capacities and share they are representing for the water supply on the state level. Also data were collected on the implementation procedures for surface DWS.

Analyses of drinking water protection zones, their implementation procedures and practices were based on careful inspection of all available documents. We have analysed the questionnaires, special reports as well as national documents where drinking water protection zones principles were enacted and described. During the preparation of the document scientific and technical literature was also consulted.

General task of the DWPZ analyses in the IPA Adriatic was to establish their basic characteristics for each state and then try to establish if common grounds and connections between them exist. Therefore the approach was divided in the following steps which represent also the main chapters of our report. In the first step analysis of national legislation of each state was performed. In this step we try to classify legislation in certain classes and observe how these classes are corresponding between countries in the region. The very important part in the understanding of DWPZ is classification of drinking water sources; many efforts to understand these matters were put. Each legislation implementing DWPZ is based on the classification and understanding of the types of water sources weather they are understood in the technical manner (e.g. wells, drains, etc.) or as natural entities (e.g. karstic aquifers, alluvial aquifers, lakes, etc.). Based on this understanding analysis of DWPZ design and principles followed; they are divided into subgroups; groundwater and surface water DWPZs. Important part of DWP is represented by protection measures; how they are implemented and how they are structured is particularly pertinent in cross-border drinking water sources protection. Where it was possible relations and classifications were represented by graphical schemes.

Final chapter consist of guidelines and recommendations. This chapter is prepared based on all DWPZ analyses performed as well as on the discussion with project members. In large part guidelines and recommendations are following experiences

gained during similar project between Republics of Austria and Slovenia (Brenčič et al., 2013) and project ISTRA-HIDRO (Prestor et al., 2016) finished just recently where detailed analysis of cross border drinking water sources and protection activities in the karstic regions Slovenia and Croatia border region were investigated and protection suggested.

2.1 Terminology

In the study are participating eight states, where legislation and technical documents are prepared in different languages and under different legal and technical conditions and traditions. In the preparation of the document some terminological problems arise which are the consequence of different hydrogeological terminology which is not only the consequence of different wording but also shows on slightly different understanding of the same natural phenomena which are related to water sources. Problems with terminology are also related to the translation from states official languages to technical English of the report using different approach and different terminology.

For the clarity several terms are defined in the advance.

Water body is any volume of water appearing naturally or as a consequence of the artificial intervention or construction, whether it is surface water body or groundwater body.

Water source is water body where water is used as source for any demand (e.g. energy, irrigation, drinking water supply, etc.).

Drinking water source (DWS) is defined as water source when water is used for drinking water supply.

Cross border drinking water source is that source where recharge area is in one side of the state border (upstream / gradient location) and water capture from this source is on the another side (downstream / gradient location) of the state border.

Drinking water protection (DWP) consist of various measures which can be divided into three groups; measures, restrictions, and prohibitions.

Drinking water protection zones (DWPZ) are spatially defined zones in the recharge of the DWS intended to protect recharge and water reserves of DWS. Usually they are organised hierarchically with stricter regime around the capture zone and less strict on other parts. In the available documents and literature DWPZ are very often

synonymously defined as safeguard zones, drinking water sources protection, or sanitary zones, throughout the text we are using safeguard zone.

Expert grounds are document or series of documents where all relevant information regarding DWS are collected and where design of DWPZ is presented and reasoned. They are usually consisting of two parts, first part is in the textual form and the second part presents all relevant spatial information in the form of maps. Nowadays very often these documents are presented in the electronic forms using GIS technology.

Design of drinking water protection zones is a technical procedure based on which spatial distribution and extent of each of the DWPZ is defined.

Enactment of drinking water protection zones is legal procedure with which DPWPZ designed by the expert and presented in the expert grounds document is enforced in the legal document which is than binding for the all parties acting in the space covered by DWPZ.

Implementation of drinking water protection zones is practical procedure where passive and active protection measures are performed. Passive measures are performed with the inspection and active with various technical measures.

Water capture device is artificial device with which water for drinking water supply is captured. It can be pumped out by wells and drainage galleries or it can flow out freely under the influence of gravity forces (e.g. drainage gallery, spring).

Capture zone is the area of the immediate surrounding of water capture device. Usually it is fenced to prevent access of unauthorised persons.

Recharge zone is spatially extended area from where water is flowing toward the spring, water course or artificial water capture device. In some documents the term 'contributing' area is synonymously used.

Hazard is any source of potential damage, harm or adverse health effects on something or someone under certain conditions.

Risk is the chance or probability that a person will be harmed or experience an adverse health effect if exposed to a hazard. In our case hazard is presented with contaminated drinking water.

Vulnerability is used as vulnerability of DWS. It is a measure of how easy or how hard it is for pollution or contamination at the land surface to reach a DWS. Vulnerability is high if natural factors provide little protection to shield DWS from

pollution. Vulnerability is low, on the other hand, if natural factors provide relatively good protection and if there is little likelihood pollution will result in degradation of DWS.

In the report we distinguish pollution from the contamination. Pollution is the introduction of contaminants into the water body. It can be understood as a process. Contamination is the presence of an unwanted constituent in the water of water body. It can be understood as a state of the water body.

3 STATUS OF THE DRINKING WATER SOURCES IN THE REGION

Understanding of natural conditions in the recharge zone and knowledge about existing technical facilities for water capturing is important for implementing proper, useful and efficient drinking water protection measures. Design of drinking water protection zones depends on the nature of drinking water source.

In the IPA Adriatic region both groundwater and surface water bodies are used for water supply (Table 1). In all countries supply from surface water is subordinate in comparison to groundwater. The only exception is Montenegro where drinking water supply from surface water bodies represents between 60 – 90 % of the total supply. In majority of the countries (Bosnia and Herzegovina, Italy, Greece) drinking water supply from surface water bodies represents between 10 – 30 %. In the same interval is also Serbia, where 30 % of the water supply is coming from the surface water bodies. In Croatia and Slovenia less than 10 % of drinking water is coming from surface water bodies.

Different types of aquifers and surface water are used. In Bosnia and Herzegovina, Greece, Italy, Slovenia and Serbia exist also DWS which can be classified as mixed, where contribution of both surface water and groundwater is present. In Bosnia and Herzegovina, Greece, Italy, Slovenia and Serbia exists DWS which can be classified as water sources with artificial recharge where water is infiltrated in the ground through special infiltration devices. More detailed classification of DWS in the IPA Adriatic region is given in the next chapters. It is reported that in Italy also marine and brackish water is used for water supply. In Montenegrian legislation for drinking water protection it is also supposed that marine water can be used for water supply.

Data of the relation between water supply from surface water and groundwater bodies as well as further information on the subtypes of water sources unfortunately are not known for Albania.

4 ANALYSIS OF RELEVANT LEGISLATION

Principles and implementation of drinking water protection zones are defined under the various national legal frameworks which addresses the drinking water protection zones at different levels. Usually at the national level there is the umbrella law either the environmental or water law which defines principles related to general environmental protection principles or water management. Under the umbrella law follow various laws and their implementation are responsibility of various state ministries or local authorities. Structure of laws in large part depends on the internal state organisation and regionalisation of the country. In some countries there is no regional structure (e.g. Slovenia) while in others, especially larger countries, they have strong and very independent regional structure (e.g. Italy) where regional authorities have many responsibilities and executive rights. In those countries by legislative procedure state defines only general principles; executive principles are defined by local governments and authorities. These principles are illustrated in Table 1.

In European Union framework legislation is Water Framework Directive (2000/60/EC), which sets general framework for water sources protection. Under this frame general principles for water environment protection are defined as well as general drinking water protection principles. Indirectly, protection zones are defined also in the EU Drinking Water Directive (Council Directive 98/83/EC), which concerns the quality of water intended for human consumption. Non EU member states cooperating in the DRINKADRIA project are following similar guidelines as set in the Water Framework Directive.

Member countries of EU implemented Water Framework Directive and consequently requirements for drinking water protection in their national legislation into the umbrella law dealing with water issues; Slovenia and Croatia implemented it in the Water Law and Greece in Law 3199/2003 Off.Gaz.280/9-12-2003 which is not entitled as a Water Law but it deals with water issues in general terms and can be recognised as Water Law. The exception from this approach is Italy where Water Framework Directive and consequently requirements for drinking water protection are covered under the Environmental Code (so called “Norme in Materia Ambientale”). In non EU states (Bosnia and Herzegovina, Serbia and Montenegro) drinking water protection is covered under Water Law. In Albania drinking water protection is covered under slightly different legal frame called "Law on integrated management of water sources" which does not possess all the characteristics of Water Law as it is implemented in other states.

Table 1: Relations among different umbrella laws in DRINKADRIA countries under which drinking water protection zones legislation is enacted

	AMBIENTAL LAW	WATER LAW	
WATER FRAMEWORK DIRECTIVE	Italy	Croatia Greece Slovenia	EU MEMBER STATES
	NONE	Bosnia and Herzegovina Montenegro Serbia Albania	NON-EU MEMBER STATES

Implementing acts and implementing procedures for drinking water protection zones are different among the countries. They can be divided according to the regional structure of the state and responsibilities of states regional units into three groups. In the first group drinking water protection is sole responsibility of the state, in the second group drinking water protection is sole responsibility of the regional or local units and in the third group drinking water protection is result of the agreement between government and regional units (Table 2).

In the first group are Albania, Montenegro, and Slovenia, which can be recognised as relatively small states. In Albania River Basin Authority deals with DWPZ implementation; than implementation of DWPZ is suggested to various ministries and finally protection measures are enacted by the state decree. In Montenegro protection measures are enacted at ministerial level. In Slovenia according to the Water Law state is responsible for drinking water protection, but in practice states negotiate within different sectors (ministries) and with local communities in implementation of DWPZ. This has the consequence that implementation procedure is rather slow and since the implementation of "Water Law" in 2000 and implementation of "Decree on the criteria for drinking water protection" in 2004 only few new DWPZ were enacted. As the result of slow enacting procedure for implementation of new DWPZ in Slovenia old DWPZ implemented before 2000 are still emplaced; those DWPZ called as “Drinking water protection zones at community level” were enacted under old local community structure and some communities that implement them were reorganised and don’t exist anymore.

In the second group is Italy. Italian administrative units - regions must identify safeguard zones, based on a proposal made by local authorities and can be enforced by municipalities and province administrations (Nardi et al., 2015).

In the third group are majority of states involved in the project; Bosnia and Herzegovina, Croatia, Greece and Serbia. Their practices are different and depend on the political system and regional organization, but in all cases obligation of the state authorities and regional or local authorities is to cooperate. In Serbia and Bosnia and Herzegovina initiative is at local community who propose implementation of DWPZ to the state (Serbia) or to the River Basin Authority (Bosnia and Herzegovina) which is organized at the state level. In Croatia implementation of the DWPZ depends on the scale inside of the administrative units; if the DWPZ is positioned only inside of the territory of the local community then it is only its responsibility, if DWPZ covers wider area going over the borders of local communities than regional authorities are responsible for the implementation, and if DWPZ goes over borders of regional units, state is responsible of its implementation. In Greece DWPZ are defined based on the proposals from regional water authorities with the agreement of health authorities, and finally based on this proposal DWPZ is implemented at the ministry level.

Important part of the implementation of DWPZ is the document which defines the procedures and criteria for their delineation. They can be defined in the law, in the special ordinance or rule or in the guidelines which have to be followed according to legislation demand. Special ordinance or rule is defined in Croatia, Bosnia and Herzegovina, Montenegro, Serbia and Slovenia. In Albania DWPZ are defined in the law entitled “Law on integrated management of water sources”. Guidelines are defined for Italy and Greece but with different approach. In Italy guidelines are defined based on the agreement between the state and regions and are enacted through the legislative decree. In Greece implementation procedure is defined based on the river basin management plan. The experts preparing river basin management plans for each of water districts prepare a programme of measures which includes measures for the protection of DWS. These principles are illustrated in Table 2.

Table 2: Implementation level of drinking water protection zones

Implementation level		
Local / Regional	Cooperation at different levels	Ministerial / State
Croatia Italy	Bosnia and Herzegovina Greece Serbia	Slovenia Albania Montenegro

5 CLASSIFICATION OF DRINKING WATER SOURCES

5.1 General principles

Implementation of DWP activities is possible only on the basis of the pre-established DWS classification. Each drinking water source has its own specificities which influence its protection and management. To implement DWP on the state or regional level it is important to introduce common methodology which defines general features of DWS present in the state. Characteristics of drinking water sources depend on the natural conditions in its recharge area as well as on the socio–economic conditions of the area where protection takes place in the space.

Classification of drinking water sources is usually imbedded into the implementing legislation. This classification, depending on the state, is more or less explicit. In some of the states classification in legislations is defined explicitly and DWPZ implementing procedures are defined followed these classes. In other states general principles for water protection are defined before the classification of DWS is given. After DWS are listed for which these principles are valid.

All states included in the study understand division of DWS into two general classes followed from the understanding of hydrological cycle where two big subsystems of groundwater and surface water are present. Therefore, in all states participating in the investigation, DWPZ technical legislation separate DWS into two big classes; groundwater DWS and surface water DWS.

5.2 Groundwater DWS and aquifers

5.2.1 General classification principles

Classification principles of groundwater DWS among states can be divided on two principles of DWS understanding. First is classification of DWS based on *natural characteristics principle* and second one is on *technical principle*. *Natural characteristics principle* can be understand through the definitions based on the hydrodynamic characteristics of groundwater flow. *Natural characteristics principle* is implemented in Slovenia, Croatia, Bosnia and Herzegovina, Serbia and Montenegro. In spite of the fact that in Albania in the legislation the classification principle is not explicitly defined it can be understood they similarly perceive DWS as before mentioned states. *Technical principle* can be understood also as an operational classification which is related to managing of technical facilities at capturing area.

Technical principle of DWS division is implemented in Greece and Italy. *Technical principle* and *natural characteristics principle* are interrelated according to the priority.

In some of the states first definition is based on the *technical principle* and second on the *natural characteristics principle* (Italy and Greece). In some other states first definition is based on the *natural characteristics principle* and second on the *technical principle* (Croatia and Montenegro). Other states are implementing only one classification system (Slovenia, Bosnia and Herzegovina, Albania, and Serbia).

Table 3: Number of DWS where implementation of DWPZ is based on natural characteristics principle

State	Number of DWS divisions	Intergranular aquifer	Karstic aquifer	Fissured aquifer	Combined	Low permeable cover
Albania	No division					
Bosnia and Herzegovina	2	X	X			
Croatia	2	X	X			
Montenegro	2	X	X			
Serbia	3	X	X			X
Slovenia	4	X	X	X	X	

In all participating states analysis of DWPZ in aquifers was performed and number of different DWS was established (Table 3). In Slovenia groundwater DWS are divided into four groups; intergranular aquifers, karstic aquifers, fissured aquifers and combined DWS. The latter represents combination of surface and groundwater (e.g. drainage of surface water through the bank filtration). In Croatia groundwater DWS are divided into two groups; intergranular aquifers and aquifers with fissured and fissured cavernous porosity. In Bosnia and Herzegovina groundwater DWS are divided into two groups; into aquifers of intergranular porosity and karstic aquifers. In Serbia groundwater DWS are divided into three groups; intergranular aquifers, fissured-karstic aquifers and aquifers where low permeable cover protecting direct pollution is present. In Montenegro groundwater DWS are divided into two groups; intergranular aquifers and karstic aquifers. DWS in Albania in groundwater are not subdivided into subcategories. In Croatia and Montenegro after the classification based on *natural conditions principles* is established further subdivision is based on technical characteristics of capturing facilities, therefore in both states classification of water is based on the primary *natural conditions principles* and then on the secondary *technical principle*. In Croatia capturing facilities are divided and defined based on the water yield. In Montenegro in karstic aquifers further steps for

implementation of protection strategies is based on the position of capturing facility; whether it is on the surface (e.g. springs) or underground (e.g. boreholes, drainage tunnels).

In Italy and Greece, where DWS are divided based on the *technical principle,* similar subdivision is implemented. Italy as a special type of groundwater DWS defines springs and wells or well fields. Greek as special type of groundwater DWS defines springs, boreholes and wells. When DWS is technically defined in the next step, both states define DWPZ according to natural characteristics of their recharge zone (e.g. karstic or intergranular aquifer).

5.2.2 Intergranular aquifers

All states included in the study are using slightly different hydrogeological terminology which shows on slightly different understanding of same natural phenomena. Problems with terminology are also related to the translation from states official languages to technical English of the report. In all states DWPZ are implemented on aquifers where porosity is the consequence of grains in the (unconsolidated and consolidated) sediments. In the international literature such aquifers are defined as porous aquifers or aquifers with intergranular porosity. In the present report for such aquifers are defined as intergranular aquifers.

In the analysed legislations no direct distinction is made according to the hydrodynamic type of intergranular aquifers (e.g. confined or unconfined aquifers). Only in Serbia an aquifer with low permeable cover interpreted as semi-confined aquifer (Matić et al., 2015) is considered and therefore hydrodynamic conditions are taken into account. Hydrodynamic nature of the aquifers is important when zoning is implemented and particularly when protection measures are defined.

5.2.3 Karstic aquifers

Similar terminological differences can be detected also in relation to karstic and fissured aquifers. Discrepancies and terminological differences are related to the natural characteristics of those types of aquifers. Karstic aquifers are specific and very important hydrogeological feature of the IPA Adriatic region. In all states participating in the project karst aquifers are important DWS which contribute large part of the total water supply. These types of aquifers are complex and there are several trans-boundary aquifers in the region.

Appearance of the karstic aquifers in the region is related to karst of Dinaric Mountains calling Dinaric karst stretching from the Italy on the northwest to the Albania in the southeast. Karst in Greece is also important and omnipresent, however by internationally accepted classifications it is not defined as Dinaric karst. In spite of this from hydrogeological point of view it has very similar characteristics to the Dinaric karst. In Italy karstic aquifers are also presented in other parts then in NW part. Features of these aquifers are very regionally depended. Genesis of the karstic aquifers of Dinaric Mountains and Greece karst is related to the development of karstic channels from fissures and faults. By the process of karstification during the geological history some of the fissures are enlarged by the dissolution. Some fissures remain in the primary state and some are enlarged into the channels. Therefore, in the reality the porosity of such aquifers are of a double type; fissured and channel porosity. Some aquifers are more karstified than others and depending on the hydrogeological development their hydrodynamic characteristics can substantially differ. Based on these natural characteristics of karstic aquifers legislation differs in the implementation of DWP principles.

Slovenian legislation is the only one where groundwater DWSs are separately defined as predominantly fissured aquifers and as karstic aquifers based on the certain criteria. In Greece criteria for fissured aquifers are also defined separately, but only as distance criteria without additional requirements. Other state legislations of participating states recognize fissured aquifers as part of the karstic aquifers (e.g. Croatia where fissured and fissured cavernous aquifers are treated together; Serbia as fissured – karstic aquifers) or only karstic aquifers are recognized supposing indirectly that aquifers with fissured porosity and cavernous porosity are behaving similarly (e.g. Bosnia and Herzegovina, Montenegro).

According to the collected data no typical fissured aquifers are present and except in Slovenia fissured aquifers are not treated as separate entity. In Slovenia DWPZ on fissured aquifers are defined according to groundwater velocity; if groundwater velocity in the fissured aquifer is higher than 10 m/day DWPZ is designed according to the principles for karstic aquifers and if the velocity is lower than 10 m/day DWPZ is designed according to the principles for intergranular aquifers.

5.3 Surface water DWS

Subdivision of surface water DWS is not as unified as in the case of groundwater DWS. In general surface bodies are divided into two large groups; first group is represented by water bodies of flowing water and the second group is represented by

the water bodies where standing water is present or velocity of water is low. There is no sharp division between those two types because a velocity criterion is not exactly defined. In the questionnaire (see Annex 3) the following classification was used: natural lakes, artificial reservoirs and flowing water. In majority of national legislation natural lakes and artificial reservoirs are treated together, they can be understood as water bodies of standing water (Bosnia and Herzegovina, Croatia, Montenegro, Italy, and Slovenia). Other group is represented by the flowing waters; in this group are natural waterways (Bosnia and Herzegovina, Croatia, Montenegro, and Slovenia) and in Italy also artificial channels. In Greece different types of surface water bodies are recognised, but from their legislation follows that standing and flowing waters are treated based on the expert grounds. In Albania surface water are recognised as type of water bodies where no further distinctions are made.

Distinction between standing surface water bodies and flowing water bodies in general is understood as *per se*. Exception is legislation in Slovenia, where distinction between both types of water bodies is defined on retention times. In those standing water bodies where retention time is lower than 10 days they have to be considered as flowing water bodies.

Special group of water sources related to surface water bodies are those which are artificially recharged. National legislation is recognising them but they are not treated separately with special conditions as they are defined for groundwater and surface water.

6 ANALYSIS OF DRINKING WATER PROTECTION ZONES

6.1 Starting points

Drinking water source is recharging from the recharge area. Extend of this area depends on the capacity of DWS (e.g. total capacity defined as recharge) and on the natural conditions (e.g. geology, land use, precipitation etc.). The area from where water is recharging can be structured in the sense that in some parts of it vulnerability and risk for water contamination captured for drinking water supply is higher than in other parts. As a rule of thumb we can consider that in the vicinity of the capture zone risk and hazard for the contamination is higher than in more remote parts. There are some exceptions to this rule when distribution of velocity field of water in the recharge area is highly heterogeneous as it is the case in the karstic aquifers where areas of high vulnerability can be rather remote from the capture zone.

Risk and hazard for contamination and potential for harmful effects on drinking water supply are not equally distributed in the recharge area of DWS; therefore different levels of the protection are needed in the recharge area of the capture zone. Different spatially defined level of the protection in the recharge area is also needed from the practical reasons. Due to different reasons it is not possible to protect the whole recharge area with the same level of the protection measures; it is more economically to protect smaller areas where risk and hazard are high with strict measures and other parts of the recharge area where risk and hazard are not so high with less strict protection measures. This can be defined as a hierarchy of protection measures. As a consequence in the recharge area of DWS zones different levels of protection are established. In the report these zones are referred as drinking water protection zones – DWPZ.

DWPZ can be established based on the several principles which can be divided into three subgroups:

a) theoretical principles,
b) administrative principles,
c) combination of principles.

Theoretical principles are based on the hydraulic theory of surface water or groundwater flow and on other (hydro)geological knowledge. *Administrative principles* are based on the decisions coming from the valid legislation, existing land use practices and political conditions in administrative units. *Combination of*

principles consists of the combination of theoretical and administrative principles. These principles usually prescribe some level of the theoretical analyses of DWS and its recharge area and then in the next step based on this information administrative decisions are implemented.

6.2 Analysis of zoning principles

6.2.1 General principles

In all countries participating in the project protection of DWS recharge area is based on the zoning principles. All countries are implementing similar principles of hierarchy of protection measures where protection measures are more strict in the vicinity of the DWS capture zone than in the more remote parts of the recharge zone. In all countries the principles are also based on the classification of water sources as explained above.

Among analysed countries principles for DWPZ in intergranular aquifers are very similar and comparable. More diverse differences are present among the DWPZ in karstic aquifers and surprisingly largest differences among zoning practices are present in DWPZ for surface water bodies.

For DWPZ on intergranular media aquifers in all countries three zones are defined. The only exception is Bosnia and Herzegovina where four DWPZ are defined. There is an exception; based on the expert report which represents basis for the enactment of DWPZ only three zones can be defined (Lukovac et al., 2015). This must be justified by the conditions in the area. In Slovenia only three DPWZ are defined, but in fact four operational zones are present. There is distinction between capturing zone and DPWZ. Capturing zone which must be fenced and physically protected to prevent unauthorised access is defined by the distance from the well or capturing facility and is by the definition equal to I zone of other countries.

Description of DWPZ varied from country to country, their definitions are different but in general based on the hierarchy of protection measures they can be described as:

a) I zone – zone of strict protection with guardianship,
b) II zone – zone of moderate protection,
c) III zone – zone of surveillance.

6.3 Groundwater aquifers

6.3.1 Intergranular aquifer

Criteria for the definition of the DPWZ on intergranular aquifer are defined on quantitative values or qualitative description and the combination of both criteria. Principles for the spatial definition of DWPZ and criteria for their definition are illustrated by country on the Figures 1 and 2. In the Figure 1 we are comparing different zoning principles defined in the space of the recharge zone of the DWS. Corresponding DWPZ are marked with the same colour and on each of the sketches basic criteria are marked. When analysing criteria on which definition of borders between each zone are defined, three different sub criteria can be discerned as they are illustrated on the Figure 2. In the vicinity of the capturing facility borders are defined with the distance criteria. The middle and the largest part are defined with the travel time criteria. These two criteria are defining the travel time of water needing to reach capture facility. Travel time is defined in the saturated part of the aquifer, while travel times in the unsaturated zone are not considered. Outer borders are usually defined based on the expert judgement that has to use geological criteria to its definition. Therefore these conditions on the Figure 2 are defined as geological criteria.

In all involved countries the border between I and II zone is defined with the distance of 10 m from the water well or other capture facility. In Slovenia this zone is defined as capturing zone and must be fenced and physically protected for preventing unauthorised access. There are few exceptions to this rule. In Albania this border is defined in the interval between 15 m and 100 m, depending on the conditions in the area. In Greece this zone is defined in the interval of 10 to 20 m, additional criteria is added and it is required that from the border of I zone to well retention time of groundwater must be at least 24 hours. In nearly all cases some additional requirements are stated.

The border between II and III zone is defined based on the groundwater travel times. For Croatia, Greece and Serbia the border is defined by 50 day isochrone. In Italy this border is defined by the 60 day isochrone. In Bosnia and Herzegovina the border is defined by the 10 days isochrone but the outer border of the III zone is defined by the 50 days isochrone. From this follows that in Bosnia and Herzegovina II zone and III zone together represent what in other countries is II zone. In Montenegro border between II and III zone is defined based on the exploitation: if DWS capacity is less than 10 l/s distance between borders II and III zone must be at least 10 m, if capacity is in the interval of 10 to 50 l/s the distance must be at least 50 m, if the capacity is

higher than 50 l/s the minimum distance is at least of 50 m but it must be determined based on the geological analysis. In Slovenia 50 day isochrone defines border between I and II zone, but I zone in Slovenia is equivalent to II zone in other countries, and II zone is equivalent to III zone in other countries.

Definition of outer border of III zone is more complicated. In general it is defined by isochrone but some additional conditions are given. In Croatia definition of the outer border of III zone depends on the retention time and DWS maximum capacity, similarly as for the border between II and III zone in Montenegro. If the capacity of DWS is less than 20 l/s border is defined by the isochrone of 5 years, if the capacity is in the interval between 20 and 100 l/s isochrone is defined by 15 years and if the capacity is higher than 100 l/s isohchrone is defined by 25 years. In Italy the border is defined by 365 days isochrone. In Montenegro the outer border of the III zone is determined based on the exploration capacity and expert judgment of the possible pollution potential. In Montenegro outer border of IV zone is defined as watershed limiting the total recharge area of DWS, however based on the expert judgement this zone can be omitted. Recharge zone must be included into DWPZ also in Slovenia. The outer border of the III zone is determined as a border of the total recharge area or it is defined based on the water balance of DWS as a ratio between the infiltration and exploitation capacity. In spite that it is not defined in the rules, the practice is when this zone is to large based on the expert judgement that it is not completely extended until the watershed.

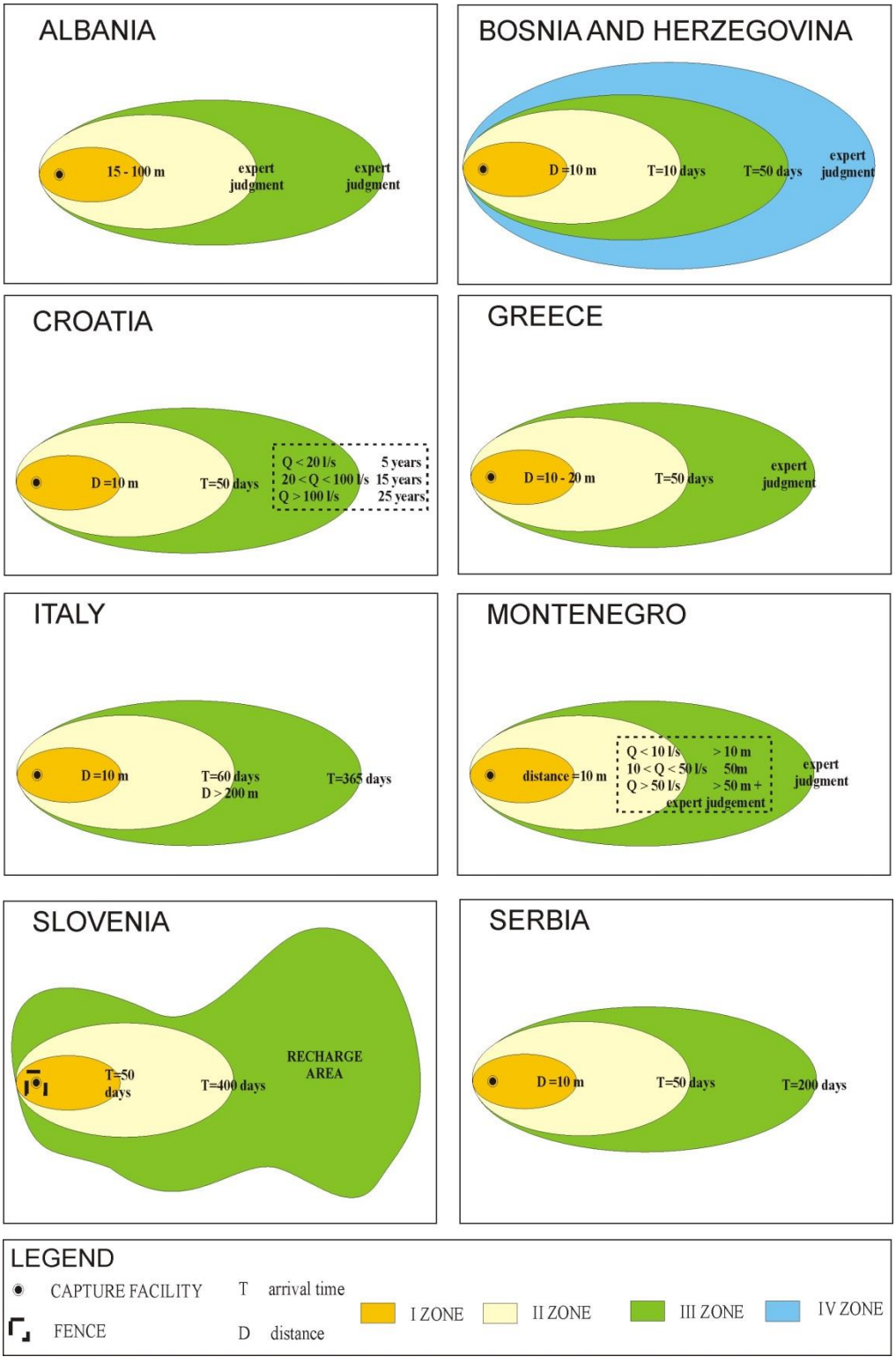

Figure 1 Drinking water protection zones for intergranular aquifers

In Slovenia border between II and III zone is defined by the 400 days isochrone; with similar value as in Italy.

In Albania borders between II and III zone and outer border of III zone are not quantitatively defined. Only general conditions are given for the definition of this border.

Some of the countries are allowing omitting II zone of moderate protection. This is possible when in the area of zone II is covered with low permeable cover. In such case expert should judge and justified if the omission of this zone based on the qualitative criteria is possible. In Serbia omission is possible only if semiconfined aquifer is present.

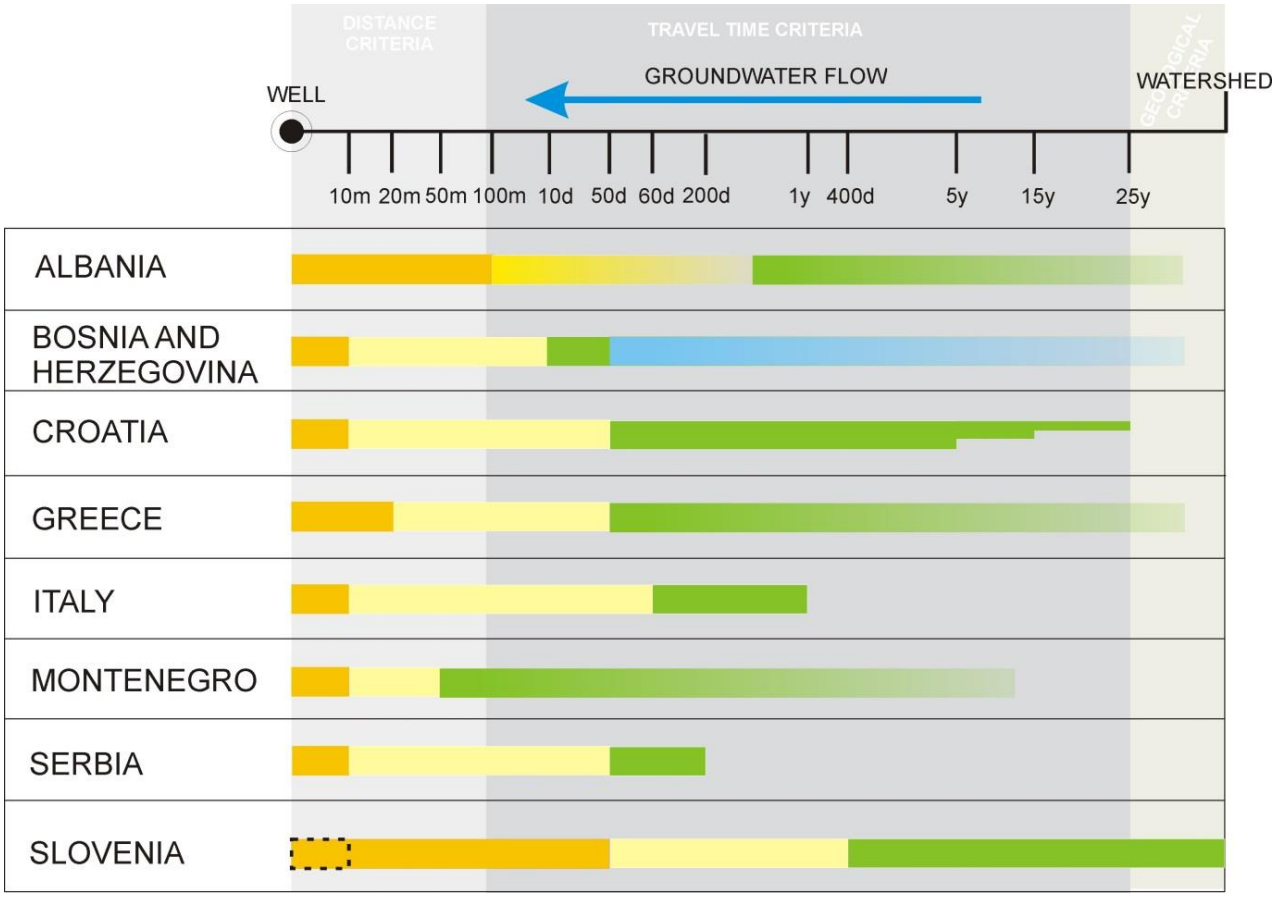

Figure 2 Comparison between criteria for the determination of drinking protection zones for intergranular aquifers

6.3.2 Karstic aquifers

Karst and karstic aquifers are natural conditions that are very specific for the region. In all participating states DWS for these aquifers supply important share of drinking water. Basic characteristic of karstic aquifers is their high non-homogeneity and anisotropy which consequently requires implementation of different principles of DWPZ design than in the intergranular aquifers.

Procedures for the design of DWPZ are very much related to natural characteristics of the karstic aquifer and on the second hand also how these natural characteristics are understood by the hydrogeological profession in the country and how these principles are implemented in the technical legislation. In large part karstic DWS belonging to the Dinaric karst, which is in hydrogeological profession more or less understood on the common grounds and consequently understanding of the processes and natural conditions are similar, there is more or less an agreement on the conditions in these types of aquifers. Basic principles of DWPZ design for participating countries are illustrated on the Figure 3. As it can be seen there are certain similarities and also differences in transferring criteria of groundwater flow dynamics to the zoning principles. For karstic aquifers it is not possible to produce similar illustration as it is given on Figure 2 for intergranular aquifers. Criteria for the DWPZ definition and design are combination of travel times, distance criteria and hydrogeological judgement of level of the karstification in the recharge area.

According to the number of DWPZ in the recharge area countries can be divided into two groups. In the first group are countries which have three protection zones; these are Albania, Greece, Italy, Montenegro and Serbia. In the second group are countries which are implementing four protection zones; these are Bosnia and Herzegovina and Croatia. In this group we can include also Slovenia, which has nominally three protection zones, but capturing area is treated as a separated and fenced zone in which in fact represents an independent zone.

In *Bosnia and Herzegovina* DPWZ are formally defined for each entity separately, but in practical reality criteria they are very similar and can be described together. It is required that I zone is fenced; it is defined with the distance of 25 m around capturing facilities. In this zone ponors, caves and potholes where water at high conditions flows toward the direction of capturing facility in less than 10 days must be included. The distance of 25 m can be reduced to 10 m if geological investigations proved there is no danger for pollution in the immediate region between 10 and 25 m. In some of the special cases where with the expert judgement risk is estimated to be high the zone can be widened. Outer border of the II zone is defined by the travel time of 1 day in some cases the zone must be enlarged to the area inside of the

recharge zone where the velocity of groundwater is higher than 2.5 km/day (e.g. ~ 3 cm/s). The outer border of the III zone is defined by the travel time of less than 10 days or with the groundwater velocity in the interval between 1.0 km/day (e.g. ~ 1 cm/s) to 2.5 km/day (e.g. ~ 3 cm/s). The outer border of the IV zone is defined based on the hydrogeological basin determination; this is the area from where groundwater flows toward the capturing facilities.

In *Croatia*, similar as in the intergranular aquifers, design of the DWPZ in karst is related to the capacity of DWS. This country has one of the more elaborated systems of DWPZ on karstic aquifers. They are divided into three groups; first group is represented with the capacity lower than 20 l/s, second group is represented with the interval between 20 to 100 l/s and the third group has capacity higher than 100 l/s. They are implementing four zones, which goes from the zone of strict regime and protection to the zone where only surveillance is necessary. Legislation in Croatia allows also establishing special protected areas in the sense of water protection reserves in the remote and mountainous regions where several DWPZ can be joined together. According to the capacity of DWS criteria are defined. First zone is intended to protect all the capturing facilities (e.g. springs, wells, drainages, etc.) and the area which directly drains toward these facilities. Extension of this zone is equal for all capacity groups. The border of the second zone is defined by the residence time which should be lower than 24 hours and at the same time it should include all the regions where velocity of groundwater is higher than 3 cm/s. In the second zone also regions in the zone III and IV must be included where direct infiltration (ponors and sinking zones) into the aquifer is present. Direct infiltration zones must be fenced. Outer border of the III zone is again defined with the velocity criteria; in this zone are included regions with the velocity of groundwater in the interval between 1 to 3 cm/s and with the retention time in the interval between 1 and 10 days. Outer border of the IV zone is defined according to the groups defined before. In the first group boundary is defined with the travel in the interval between 10 and 20 days, in the second group with the interval of 20 to 40 days and in the third group with the interval of 40 to 50 days.

In *Greece* karstic DWS are recognised as important but DWPZ are as precisely elaborated as it is the case on the rest of Dinaric karst. First zone is defined in the similar way as it is in the intergranular aquifers with the distance from the capture facility. Second zone in the karst is defined by the distance criteria and based on the analyses of karstification level; in the upstream direction of the capturing facility the border is defined with the distance of 600 m, in downstream direction the border is defined with the distance of 200 m. By the expert judgment outer border of the III zone is defined as a border of recharge area. It is worth to mention that for the

fissured aquifers, which in some cases are similar to karstic aquifers, in Greece second zone is also defined by the distance criteria; in the upstream direction of the capturing facility the border is defined with the distance of 400 m, while in downstream direction the border is defined with the distance of 150 m.

Italy is a state where karstic aquifers are also very important source of drinking water. But according to the geological conditions are very different across the country. In the north-eastern part of Italy karst is part of large Dinaric karstic system. In the north it is part of the calcareous Alps and in the rest of the country it is related to regional structure of Apennines and sometimes is represented with the large systems and sometimes as limited karstic systems. Another constraint is socio-economic, in Italy strong regional system is present and responsibility of DWS protection is at that level. Therefore, approaches to the protection are differing and are not unified across the whole country. At the same time it has to be stressed that methods used in Italy for the design of DWPZ are very elaborated and variegated prescribed also in the legal documents, therefore they can be applied on karstic regions. From the available documents follow that karstification of the aquifers is recognised entity of the various recharge zones and it must be considered when designing DWPZ. Especially it is emphasised that those regions which are directly connected with capturing facilities must be included in the second zone, as a consequence spatial coverage of DWPZ is related to the geological structure and geomorphological conditions in the recharge area. In general we can recognise that first zone in karstic aquifers is defined similarly as in the case of intergranular aquifers, second zone is defined with the travel time of 60 days but it must consider existence of karstic zones. Outer zone is defined on the expert judgement analysis and must consider definition of hydrogeological basin and total recharge zone.

In *Montenegro* specific conditions in karstic groundwater are recognised in the legislation. Conditions for designing DWPZ are not strictly defined but according to natural conditions in the recharge zone of karstic DWPZ rules implemented for the definition of DWPZ in intergranular aquifers must be meaningfully applied. Great role of expert preparing expert grounds is stressed and hydrogeological investigations are needed to define protection zones and measures on them. First zone can be interpreted similarly as in the case of intergranular aquifers; borders of other two zones are defined by the expert judgement based on the hydrogeological investigations performed.

Slovenia is cover in nearly 50% with karst and therefore karstic aquifers are representing large part of the DWS. Rules for the DWP design are relatively well elaborated. As a karstic DWS are in general defined those where average

groundwater flow velocity is larger than 10 m/day. Therefore, even if by hydrogeological conditions the aquifer is not treated as karstic (e.g. fissured or some conglomerates) the DPWZ must be designed according to the criteria for karstic aquifers. Borders between DWPZ in karstic aquifers are defined according to time needed to intervene in the case of contamination to prevent damage at water facility and at the same time design is based on the residence times and possible dilution of pollutants. In Slovenian legislation special zone is defined as fenced zone which is officially not part of the other DWPZs. If capture facility is on karstic spring the perimeter of this zone must be at least 25 m, for other facilities it is the same as I zone in the case of intergranular aquifer. First zone is defined by the groundwater travel times of less than 12 hours. In this zone all main water flowing directions must be included as well as all zones with direct infiltration into the groundwater (e.g. ponors, poljes). Second zone is included with those areas from where the travel time of groundwater is more than 12 hours and can be interpreted as karstified areas. The third zone is defined by all other parts of the recharge zone which should be included in total in this zone. In the case when low permeable bed is present with the thickness of more than 8 m and covers karstified features they can be treated as a part of third and not second zone.

In *Serbia* on karstic aquifers first protection zone is defined in the same way as in the intergranular aquifers. Second zone is defined according to the hydrodynamic conditions and possible existence of low permeable layer on the top of the aquifer. If there is no low permeable cover and groundwater level is free, than travel time distance is set up at 1 day. If the aquifer is confined and low permeable cover exists the border is defined by the distance of 500 m or more. If areas with direct infiltration into the groundwater are present (e.g. open fault zones, ponors, dolines, infiltration zones) in the second zone on them, same protection measures must be implied as in the zone I. If low permeable bed which prevents contamination of the aquifer is present above than zone I can be joined with zone II and it transfers to zone II. Third zone is also defined according to the hydrodynamic conditions and possible existence of low permeable layer on the top of the aquifer. When free groundwater is present outer border of the third zone is defined by border of the recharge zone. If low permeable cover is present or aquifer is under the confined condition the outer border of the third zone must be at least on the distance of 1000 m from the capture zone. If areas with direct infiltration into the groundwater are present (e.g. open fault zones, ponors, dolines, infiltration zones) in the third zone on them same protection measures must be implied as in the zone I. The rules allow joining of the second and the third zone in the case when low permeable bed at the top of the aquifer prevent any contamination and in this case area of second zone becomes third zone.

In *Albania* DWS in karstic aquifers have no special rules for designing and implementation of DWPZ, the same principles must be applied as they are on the intergranular aquifers.

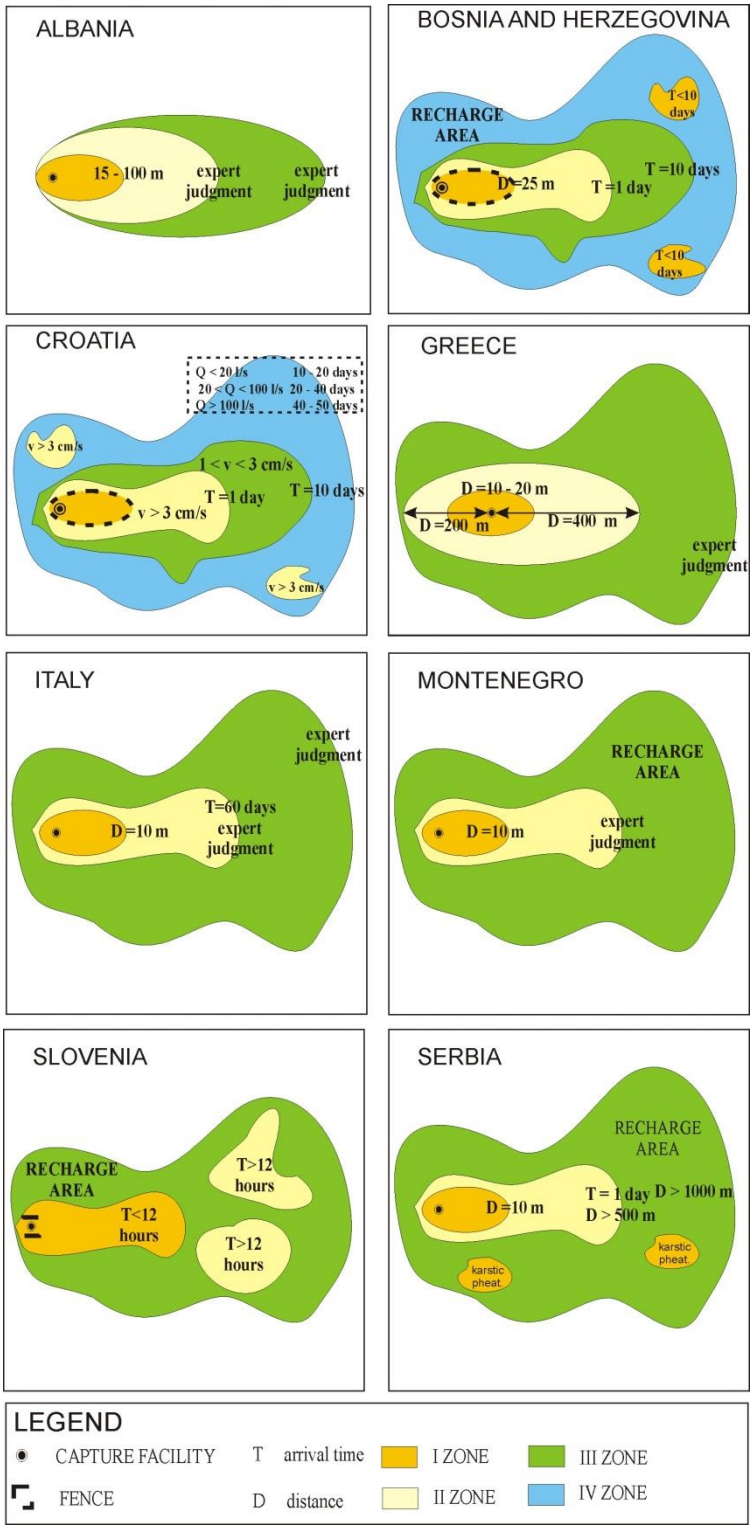

Figure 3 Drinking water protection zones for karstic aquifers

6.4 Surface water bodies

Criteria for DWPZ for surface water bodies are described in two subchapters; one chapter is dedicated to natural or artificial lakes and reservoirs defined as standing waters and the next subchapter is representing drinking water protection zones on rivers, creeks, streams and artificial waterways. These water bodies are defined as flowing water.

6.4.1 Standing waters

Conceptual models of drinking water protection zones around standing water bodies are graphically represented on Figure 4. As before diagrams have been drawn on the basis of legislation analysis. For Albania and Greece these type of DWPZ are not specified and therefore not shown.

In *Bosnia and Herzegovina* for standing water DPWZ they are recognising two zones. First zone is defined with the area of 50 m around the natural or artificial lake. The representative stage (water level) of the lake is defined at maximum state and the contour reached is a starting point for the distance definition. Capture facility must be fenced and signs with warning around first zone must be placed. Second zone extends at least 100 m from the border of the first zone. If necessary the protection zone should include also streams in flowing into the lake. The need for this must be determined in the document of expert grounds.

In *Croatia* for standing water DPWZ they are recognising three zones. First zone includes water surface and all the facilities needed for water capture and supporting buildings, including the dam if exists and it is defined with the 10 m zone around the lake at his maximum stage. All the capturing and supporting facilities must be fenced. The second zone is defined with the distance at least 100 m from the border of the first zone. The outer border of the third zone is defined with the watershed. It is determined only for those natural lakes or artificial accumulations where no surface water inflow or torrents are present.

In *Greece* DWPZ on surface waters are not defined by any legislative document. Current practice is that they are defined based on particular study which is elaborated and included in the context of the River Basin Management Plans and related Programmes of Measures.

In *Italy* for standing water DPWZ they are recognising three zones. First and second protection zone very often coincide. It is intended that this zone represents circle of 200 m with the capturing facility in the centre. When the borders of the zone are not reaching the opposite bank it has to be extended also to this area. The third zone is

defined based on the expert judgment which in the study has to include all the characteristics of the area (natural and socio-economic conditions). Measures in this zone must be part of the River Basin Management Plans and related Programmes of Measures.

In *Montenegro* for standing water DPWZ they are recognising three zones. In the first zone surface of natural or artificial lake and all the facilities for water capture are included; the capturing facilities must be fenced. The zone extends on the banks around the lake in the distance of 10 m; this distance is determined from the normal lake stage. Second zone extends 100 m around the lake measured from the borders of the first zone. If surface water inflow into the lake exists on the both sides of the stream bank 50 m wide zone is defined. It extends in the upstream direction until the end of the stream. Third zone is defined only in the case that no surface stream inflows exist. It extends to the surface watershed of the lake. Montenegro is the only state which defines DWPZ also for the sea water which conditionally can be also observed as standing water. They are defining only first zone which has to extend 10 m around capturing facilities and which have to be fenced.

In *Serbia* for standing water DPWZs are divided in three zones. The first one zone includes natural or artificial lake surface, dam for the latter if it is present, 10 m area which extends on the bank around the lake defined at high water level conditions and inflows to the lake and their bank area of 10 m width on each side defined for 10 year event. The border of the second zone is defined by the 500 m distance from the border of the first zone. The third zone is defined as a border of the watershed – recharge area.

In *Slovenia* for standing water DPWZ they are recognising three zones. Among the analysed criteria these criteria are the most elaborate and detailed in spite of the fact that in Slovenia only few DWS from surface water exist. Criteria for the determination of DWPZ are of three types (method of distances, method of isochrones and method of intervention measures). Their application is depending on the natural conditions of the recharge area as well as on the activities and facilities for capturing water. When determined with the method of distances first zone is extended 100 m around the lake where distance is determined at the lake stage at return period of 100 years. Second zone is around the lake extended on the distance of 100 m from the border of the first zone and 100 m around the banks of the inflowing surface water. When method of isochrones is applied for the border of the first zone travel time of 10 days is used as a criteria with the condition that width of this zone around the lake and inflowing streams is not less than 100 m determined at the stage of 100 years return period. The border of the second zone is determined with the travel time of 20 days.

For intervention measures first zone is determined with the travel time of 4 hours which is the same as the time needed to intervene. Second zone is determined with the travel time of 12 hours which is again the same time as needed to intervene. The distances of DWPZ should not be shorter than in the case of distance criteria. Criteria for the third zone in all three cases are the same; it has to be extended till the borders of surface watershed.

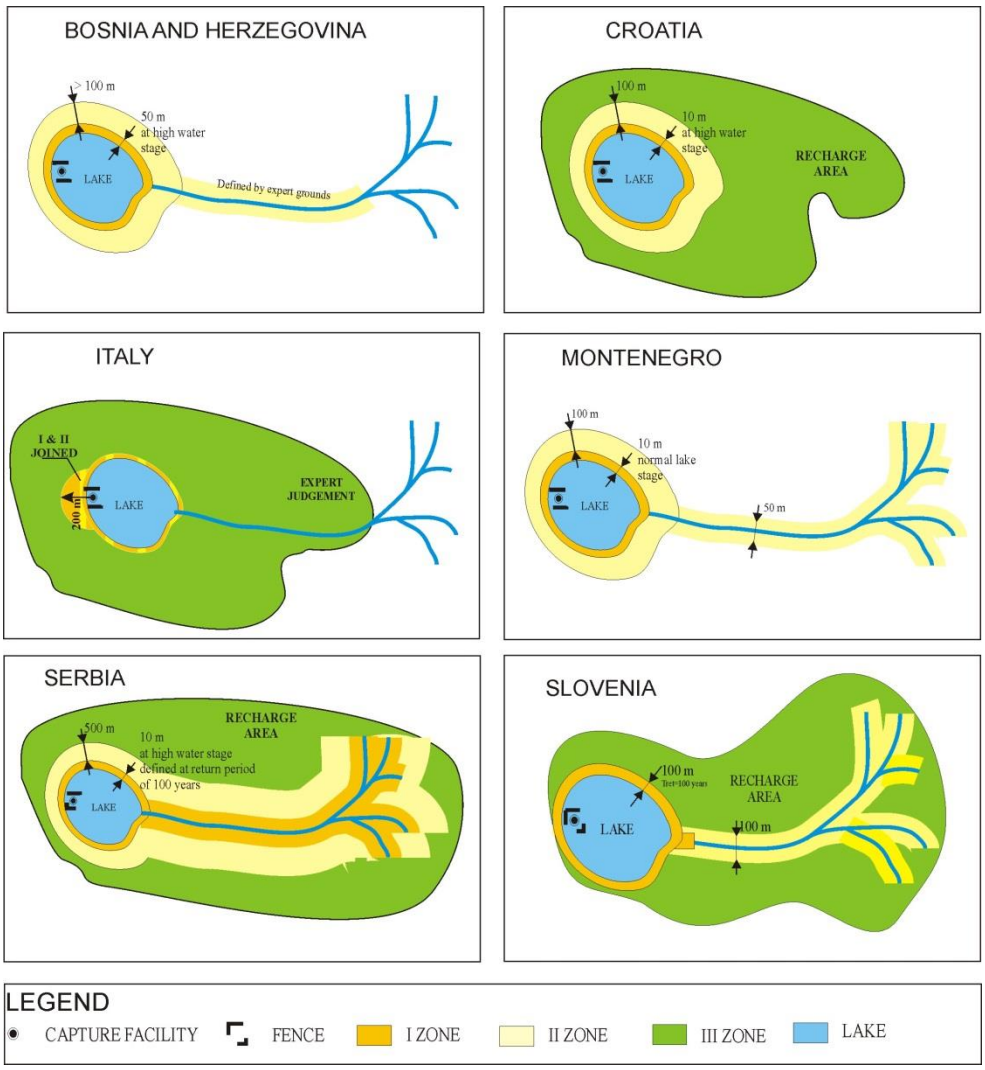

Figure 4 Drinking water protection zones around lakes and reservoirs

6.4.2 Flowing waters

In *Bosnia and Herzegovina* for flowing water they are recognising two DPWZ. First zone is positioned immediately around the capturing facility. If it is positioned in the stream it has to be separated with buoys and fence not lower than 2 m on the banks of the stream. First zone extends to the distance of 25 m. Second zone extends in the distance of 1000 m in the upstream direction on the banks and the width of the zone is defined by 50 m on the each banks measured from the stream stage at the return period of 100 m.

In *Croatia* and *Montenegro* they are using the same criteria for flowing water DPWZ and are recognising only one zone. The border of the zone must be at least in the distance of 10 m from the capturing facility. If the stream bed is less than 20 m width, than the zone should extend at least 10 m on the other bank of the stream. All the capturing and supporting facilities must be fenced.

In *Serbia* for flowing water DPWZ they are recognising only one zone. Protection zone is defined in the distance of 100 m in upstream and downstream direction; its width in the downstream direction is at least 20 m and in upstream direction at least 30 m on both banks respectively. If capture facility is positioned in the stream it has to be separated with buoys or in the banks unauthorised access must be prevented.

In *Italy* on flowing waters DPWZ they are recognising three zones. First zone is defined as the area of 10 m around the capturing facility. Second zone extends in the at least 200 m upstream distance and must be defined based on the discharge characteristics. The width of this zone is determined based on the risk calculations. The third zone is defined based on the expert judgment and have to include all the characteristics of the area.

In *Slovenia* for flowing water DPWZ they are recognising three zones and are determined with the same principles as for the standing waters.

In *Albania* protection zones on surface waters are vaguely defined. It can be recognized that immediate surroundings of the capturing facilities in the distance of 10 m must be fenced, next – second zone is defined by the distance of 200 m in downstream and upstream direction.

7 PROTECTION MEASURES EVALUATION

Protection measures on the drinking water protection zones are hierarchically defined. The highest and most stringent requirements are set in the vicinity of the capturing facility and they diminish in the direction toward the borders of hydrological basin of the protected water source.

In all countries the same hierarchical principle is applied (Annex 2). The exceptions of such spatial hierarchy are karstic aquifers where in some relative remote parts direct infiltration to the groundwater is possible (e.g. swallow holes) such geomorphological features are protected with more strict measures than surrounding area. Protection measures can be further classified into interdictions, limitations and measures (Brenčič et al., 2009). Interdictions are representing ban of certain activities (e.g. ban of fertilization with animal manure and artificial fertilizer. They can be further divided into unconditionally allowed activities and conditionally allowed activities which can be performed under some certain and strict measures (e.g. the internal sewerage network must be connected with the public sewerage system. Before the implementation of the internal sewerage system, water tightness must be tested with standard procedures). Limitations allowed certain activities but limit their extent and magnitude (e.g. ground excavations are allowed if the bottom of the pit is higher than 2 m above maximum groundwater level). Measures are usually consisting of activities which have to be performed to sustain present status of water body or even to improve it.

8 IMPLEMENTATION PROCEDURES

After the design of DWPZ next important step is their implementation and enforcement. Design of DWPZ must be transferred into the legal acts where their spatial extend is defined as well as protection measures which followed from the zoning principles. Important part of DWPZ implementation is also verification whether protection measures are properly implemented and to control possible violations present in the area of DWPZ.

Among the participating countries implementation measures were analysed by questionnaire entitled “Procedures of drinking water protection zones (DWPZ) implementation” (Annex 4). Analysis of the questionnaire showed that among participating countries practices in the implementation of DWPZ are very different. They are strongly related to the legal system of certain state as well as to the administrative organization of the state where level of the responsibilities at regional and local level play important role.

Emplacement of DWPZ in space cannot be enforced without interested parties and stakeholders. In all countries involved there is certain coordination with interested parties but among the countries procedures for these activities are different. In Bosnia and Herzegovina, Croatia, Serbia and partly Slovenia initiatives for the definition of DWPZ are coming from the municipality level. At this level all relevant parties are consulted. In some states the procedures of such consultations are defined by the legal act (e.g. Croatia) in other states this is common practice which is more related to the status of the relations between the local politics and state at ministerial level (e.g. Slovenia).

Albania has special implementation procedure which is quite unique among participating states. All activities are implemented under the River Basin Agency as a verification body to which initiatives DWS protection of any interested party can be transferred. According to the procedure inside of various administrative water management bodies initiative with all relevant document is reviewed and verified. Decision level is connected to the amount of water required; if demand is less than 5 L/s the procedure is conducted under River Basin Authority if larger than National Water Council is responsible for it. Similarly in Greece all DWP activities are conducted under the frame of relevant Water Districts, however according to the available documents no DWPZ are implemented yet (see Annex 4). In Bosnia and Herzegovina implementation of DWPZ is related to the extent of zones; if they are relatively small and positioned inside of the community borders than they are the meter of this community, if DWPZ cross borders of the local administration level then

they have to be implemented in the agreement with all parties involved. If DWPZ are crossing cantonal borders then they are also negotiated at this level. Similar approach is implemented in Croatia where implementation procedure is defined according to the administrative structure of the state (from local to regional and state level) and is elaborated in details in the valid legislation. If DWS is positioned inside of the municipality initiative is started at the local level, if recharge zone is larger crossing state administration bodies than all administrative units are involved. At the end of the implementation procedure state water managing authority Croatian Waters who formally conduct procedure implement them and coordinate procedures; in the process all interested parties are involved. In Serbia initiatives for DWP are starting at the local level and collusion is depending on the extent of DWPZ; similarly as in Bosnia and Herzegovina and Croatia the number of the involved parties depends on the extent of the protection areas. Formally Ministry of Agriculture and Environmental protection and Ministry of Health are responsible for the procedures and implementation. In Slovenia responsibility of DWPZ implementation is solely on the Ministry of Planning and Environment who has the exclusive right to implement them. In practice procedures are much more complicated and are result of top down approach as well as of bottom up approach. Since the implementation of new Water Law in 2000 state has launch several initiatives for implementation of DWPZ and negotiate them with the local communities, this resulted in very slowly proceeding procedures and consequently local communities realised that they have to start implementation of DWPZ by their own sending initiatives to the responsible Ministry which is reviewing relevant documents prepared by the communities. DWPZ are debated a various levels and with various stakeholders, consequently procedures are relatively long.

According to the legislation in Italy DWP is responsibility of regions. They have to prepare and implement guidelines and regulations necessary for the establishment of protection measures. However, currently no binding documents are prepared in regions and DWP is established based on the common practice. As follows from the available documents inner protection zone (e.g. well protection zone) is strictly defined but other zones are very much depending on the certain initiatives and their consideration during the process of spatial planning is very much depends on the region. During the implementation of DWPZ several parties are consulted: local communities, water authorities and managers, land owners and all other interested parties.

DWPZ are zones which are influencing management and activities on the land. Therefore it is very important to define them in the proper manner that all interested parties can have information of their position and measures necessary to be taken.

From that point we can be interested how they are spatially presented and how they are influencing ownership relations in the space.

Legal representations of the spatial extent DWPZ can be given on the maps of smaller scale, meaning that only their general position is shown or they can be illustrated on the cadastral maps where each land plot is considered. Cadastral maps are considered in Albania, Bosnia and Herzegovina, Croatia and Slovenia. In Serbia inner protection zones (e.g. DWPZ I) is defined on the cadastral map at the plot level, other zones are defined geographically or with natural borders. In Italy in cadastral map is defined only inner protection zone (e.g. well head protection zone) but other zones are defined on map of smaller scale (e.g. in scale 1:5.000). For Greece no information are available.

Parts of the DWPZ are also interdictions, limitations and protection measures. In all states considered they are usually not negotiated, especially if it is estimated by the competent authority that activities can harm the DWS. In some cases “soft” protection measures can be negotiated (e.g. Slovenia).

DWPZ are of no value if no control is exercised over their surface. In all countries first level control is performed by the water utilities responsible for management of DWS. They are implementing ongoing inspection and even perform minor infringements. Second level control is performed with the authorities who are usually responsible for the implementation of DWPZ. These are state water managing authorities or their inspector services (e.g. water inspection, health inspection, civil engineering inspection, etc.).

During the control over DWPZ it is also important that breaches of interdictions, limitations and protection measures sanctioned and punished. In Croatia and Serbia penalization of breaches is performed through the various inspectorates. In Croatia penalization is performed through water inspectorate and in Serbia with different inspection services depending on the type of violation (e.g. construction violation – construction inspectorate; sanitary violation – health inspectorate). In Slovenia breaches and penalties are defined in the Environmental Law. There are two levels of penalization. At first level the penalties is imposed by environmental inspectorate and at the second level by the competent court according to applicable law. In Greece and Italy breaches on DWPZ are not regulated by the law and therefore penalization is not performed yet.

9 CONCLUSIONS, RECOMENDATIONS AND GUIDELINES

9.1 Present status

In the IPA Adriatic region several cross border drinking water sources are presented. Implementation of their protection and agreement on their existence among the states are different. Along some of the state borders regions the situation is well recognised and even some cross-border protection measures are already implemented, as it is in ISTRA-HIDRO (Prestor et al., 2015) and in Transboundary water body of Karavanke / Karawanken (Brenčič et al., 2013). In some other regions cross border drinking water sources are recognised but no actions for protection and categorisation were taken. There are also regions where based on the geological knowledge cross-border recharge of the water sources can be expected but no steps were taken yet to better understand their natural conditions and protection measures to be implemented. In the future several efforts must be taken to improve the knowledge about cross-border water flow and to implement proper protection measures.

In the border areas where no cross-border water sources are identified, it is necessary to start with activities of geological and hydrogeological mapping based on the common and agreed methodology and after based on these results thorough discussion about geological and hydrogeological conditions is needed. In areas where cross border drinking sources are already recognised and monitoring and protection activities has started in the past, they have to be continued as well as new and additional research must be initiated. New data are always important; they are helping to improve water sources management. At the same time research activities are important from cooperation point of view; scientific investigations are one of the activities which are usually not conflicting but can help a lot in the mutual cooperation and understanding between different nations.

9.2 Legal constraints

In the proposal of the DRINKADRIA project among others the following objectives were defined and the following outputs have to be prepared:

- Common methodology for delineation of drinking water protection zones with proposal of measures for protection;

- Joint report on proposal of measures for cross-border drinking water sources protection and management for Adriatic area.

Common methodology for delineation of drinking water protection zones was rather ambitious goals which cannot be directly fulfilled due to the present status of the national legislations and legal systems in the bordering countries. At the same time new technical guidelines are not needed to fulfil drinking water protection goals in the region. As we have shown in the previous chapters, in the majority of states participating in the study, expert grounds forming platform for the design of drinking water protection zones are very similar and comparable from the theoretical point of view and there exist also similarities in the practical implementation procedures. Differences among states are present in the enactment procedures which very much depend on the legal and political system of the country. This are questions which cannot be tackled by technical issues dealing in the project. During the discussions among members of the project group and work performed on the analysis of drinking water protection zones it was agreed that is not possible to initiate and implement changes in national legislation as a result of differences among neighbouring countries where protection of cross border drinking water sources is needed. It was also agreed that it will be very difficult to establish common methodology and guidelines which will reach mutual agreement between all parties of the project. It does not mean that certain improvements of national legislations are not needed, but this must be achieved in the future and with different approaches.

Among the participating states in the project four are members of European Community and four of them are in the different status of the accession. This has very important implications in drinking water protection activities. None the less, in all states Water Framework Directive represents common background for water management and water protection.

It is also important to note that from legislation analysis it is evident that neighbouring countries are sharing their knowledge on water recourses of either type. There is more or less mutual agreement on the theoretical background for groundwater sources protection. More disagreement and differences are present in the case of surface water drinking water sources. The reason for this is that such sources in the region are subordinate to groundwater drinking water sources and also in the nature of this surface water drinking sources where similar principles and design criteria as in the aquifers cannot be applied. Some of the legislative rules in national legislations are very similar and the principles behind are having common ground. Usually, when country in the past prepared the legislation, they have taken as experience legislation from other countries with similar natural condition and legal traditions, and these were usually neighbouring countries. They use such legislation as a starting point and as base ground which was in the process of the national legislation preparation amended and transformed to the conditions valid in the country. It is also known that

for many national legislations in the IPA Adriatic region German water protection recourses principles were used as a background and this has also the consequence that mainly all legislation have more or less similar denominator.

When neighbouring countries are faced with the goal and need to protect cross border drinking water protection and initiative is agreed among the neighbours it cannot be expected that countries will change their national legislation to implement protection measures. Based on the current practices between Austria and Slovenia (Brenčič et al., 2013) and between Slovenia and Croatia (Prestor et al., 2015) it was established that changes in national legislative for water protection are nearly impossible. Legislation has a complex structure which goes from the umbrella law down to the drinking water protection zone implementation act and in this enactment procedure very different parties with different responsibilities are involved. Legislation of water protection is also intertwined with other legislation (e.g. spatial management legislation) where procedures influence each other, causing things even more complicated. These procedures are different between each country. We have to have in mind also the fact that drinking water protection zones are related with the matters of the land property ownerships and these are very difficult questions even inside of the one state let alone with the cross-border matters.

9.3 Principle of acceptable compatibility

To achieve drinking water protection goals between neighbouring countries the principle of acceptable compatibility must be applied. The phrase as such was coined in the project ISTRA-HIDRO (Prestor et al., 2015) dealt with the drinking water protection in the region of Istra and Kvarner in the border region of Republics of Croatia and Slovenia. The principle of acceptable compatibility was already implemented in the cross border drinking water sources protection in the border region between Republics of Slovenia and Austria (Brenčič et al., 2013).

It is recommended that principle of acceptable compatibility should be used for the cross-border open questions in relation to drinking water protection in the IPA Adriatic region. The principle can be relatively easily implemented because indications based on DRINKADRIA screening analysis of drinking water protection zones is showing that mainly cross-border recharge zones must be protected and only small number of cross border inner protection zones are possible to exist. This means that cross-border protection is needed mainly for the outer protection zone where protection measures are not so strict and they are based mainly on the

surveillance criteria. Therefore, they are not very demanding and it is easier to achieve agreement on the cross border protection measures.

Principle of acceptable compatibility is based on the implementation of valid national legislation for the protection of the recharge zone from where drinking water source in the neighbouring country is recharging (see Figure 5). At the same time principle of acceptable compatibility suppose that national legislations regarding drinking water protection in both states are compatible to the acceptable level that both states can agree that legislation of other state can properly implement protection of recharge area of its drinking water source.

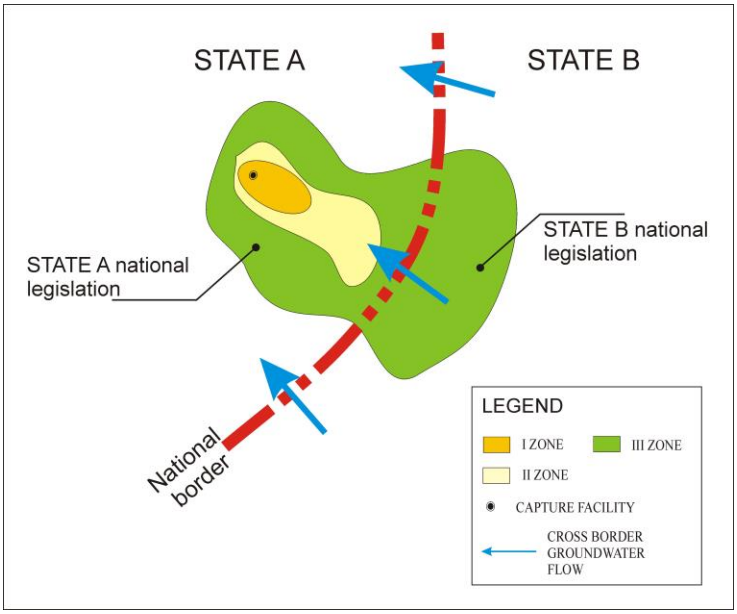

Figure 5 Principles of cross-border drinking water protection zones

In the IPA Adriatic region principle of acceptable compatibility can be easily used for the protection of drinking water captured from groundwater. All the rules are very elaborated an enable proper and effective protection. The same is not valid for surface water drinking sources. Among the states relatively big differences exist in zoning principles. In the case of such water sources involved parties should find another solution. The Water Framework directive foster implementation of common transboundary River Basin District (including surface and groundwater), including coordination of all programmes of measures. For river basins extending beyond the

boundaries of the Community, Member States should endeavour to ensure the appropriate coordination with the relevant non-member States.

9.4 Bilateral working commission

For implementing principle of acceptable compatibility in drinking water protection involved states should establish working commission responsible for the documents preparation which will form the background for the bilateral or multilateral agreement on the measures and commitments for cross-border drinking water source protection. The commission involving both (all) parties should consist of members of representatives of state authority responsible for water protection and of experts. Representatives of the state authority should have a mandate to lead the working commission and to involve in the activities of working group various experts as well as to deal with administrative matters. They should be responsible also for tackling socio-economic issues of drinking water protection zones implementation and spatial emplacement.

As members of commission's working group hydrogeologists with the knowledge of the area must be included and it is recommended that they are leading research activities as a desk studies as well as a field investigations. Important task of the expert members is the agreement on the methodology to be applied for the investigation of natural conditions and presentation of design principles for drinking water zones determination. At the same time experts must agree on the level of the map scales, legends of the maps and to agree on the terminology to be applied as well as on other deliverables.

The work of commission should be organised with regular meetings where results established between meetings were obtained and further open questions are discussed. Important part of the working commission meetings is exchange of all relevant information.

9.5 Preparation of expert grounds

Before any implementation of protection measures careful investigation of natural conditions in the cross-border region is necessary. Experiences from the past activities in the border regions from other states are showing that in spite of usually good knowledge about the geology and hydrogeology at the border regions many discrepancies are present. For the proper implementation of protection measures

these discrepancies (geological borders, hydrogeological borders, and administrative units) must be negotiated and agreed.

Protection of drinking water sources with cross-border water flow can tackle many open questions which can represents a possible conflict which have to be avoided. Therefore, it is highly recommended that at early stage of working commission all known water sources along the border are identified based on the available knowledge and to agree that water sources on both sides of the border will be treated equally. There should not be only mutual agreement about cross border water flow but the number of cross border protected zones should be balanced for both states.

In the analysis of natural conditions the following information must be obtained:

- geology of the region (preparation of mutually agreed geological map),
- hydrogeology of the region (preparation of mutually agreed hydrogeological map),
- definition of the mutually agreed hydrogeological conceptual model of the cross-border water sources,
- definition of the mutually agreed water balance with information on the yield of cross-border drinking water sources,
- identification of water sources and their recharge zones in the border region,
- identification of potential water sources for future use and identification of regions which can be defined as a water reservates.

When natural conditions are investigated and basic level of information achieved, in the next step water management issues must be launch. The following activities must be performed:

- translation of national legislation related to drinking water protection in the language of the neighbouring country,
- preparation of the document where principles for the design of drinking water zones will be presented and comparison between different approaches in both (all) states illustrated,
- preparation of map with the existing drinking water sources and their drinking water protection zones,
- translation of drinking water protection zones enactment documents (if they exist) of those water sources which have already zones extended to the state border,
- presentation and description of existing water management areas on both (all) sides of the border.

Based on the present state of the art of the mapping and data base technologies it is appropriate to prepare all the products in the exchangeable geospatially referenced data base. Internet technologies allow sharing of data on-line and on time and to build a trust in water protection procedures, previously agreed level of data must be exchanged.

9.6 International standards

If direct changes and negotiations as a result of cross-border activities about the drinking water protection principles and design procedures embedded into national legislation are difficult to be implemented, it is highly recommended to establish in the future international (or at least EU) standards on drinking water sources protection procedures for different types of drinking water sources. Urgently are needed recommended standards for surface drinking water sources protection. Such standards should be established by international standardisation organisations (e.g. International Organization for Standardization – ISO) or international expert organisations (e.g. International Association of Hydrological Sciences and International Association of Hydrogeologists). Existence of such recommended standards can represent important support to governments and legislators in how and what should be embedded into national legislation to be comparable internationally. Implementation of such standards will improve also international cooperation on cross-border drinking water protection. Such tasks are beyond the present project.

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Drinking water protection zones in the Adriatic region – state of the art and guidelines for the improvement of the present status

Let's grow up together

DRINK ADRIA

Adriatic IPA
Cross Border Cooperation 2007-2013

The project is co-funded by the European Union,
Instrument for Pre-Accession Assistance

Workpackage 4

Activity 4.4 Water (re)sources protection and cross border water (re)sources management

Drinking Water Protection Zones

ANNEX 1

Reports on legislation for determination of drinking water source protection zones from countries involved in the project:

Italy
Slovenia
Croatia
Serbia
Albania
Bosnia and Herzegovina
Montenegro
Greece

Italian legislation on Drinking Water Protected Areas

(LP, FB1, FB2, FB3)

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Table of content

1 Introduction

Protection of drinking water resources, by means of establishing protection areas at their surroundings, is specifically considered in the Water Framework Directive (WFD, Directive 2000/60/EC) through articles 6 and 7. It expresses the need to elaborate a register of all the areas included in each hydrographic district, declared as an objective of special protection by virtue of the specific commune norm related to surface water and groundwater protection or to habitat and species that depend on water conservation.

Article 7.1 of the WFD states that:

"Member States shall identify, within each river basin district:

- all bodies of water used for the abstraction of water intended for human consumption providing more than 10 m^3 a day as an average or serving more than 50 persons, and

- those bodies of water intended for such future use."

Moreover, according to Article 7.3 of the WFD:

"Member States shall ensure the necessary protection for the bodies identified with the aim of avoiding deterioration in their quality in order to reduce the level of purification treatment required in the production of drinking water. Member States may establish safeguard zones for those bodies of water."

Safeguard zones had been firstly introduced in Italian Legislation by Decree of the President of the Republic no. 236 of 1988 (actuation of Directive 80/778/EEC, Drinking Water Directive), and later by Law no. 36 of 1994 (so called "Galli Law"), on the reorganization of water service management.

The Water Framework Directive 2000/60/EC has been finally implemented in Italy with the Legislative Decree no.152/1999, later replaced by Legislative Decree no. 152/2006 (Italian "Environmental Code"). Community obligations regarding safeguards zones have been transposed into national legislation through Article 94, Part III, of the Legislative Decree 152/2006. Regions (Italian administrative units) must identify safeguard zones, on which measures and restrictions can be enforced in order to assure the protection of surface water and groundwater intended for human consumption, based on a proposal made by Local Authorities on Water Service Management (Optimal Territorial Area Government Bodies).

2 Identification and Delineation of DWPAs

According to the Italian legislation presently in force (Legislative Decree no. 152/2006, Art. 94) safeguard zones are divided into:

1. *absolute guardianship (or protection) zone:* an area of at least 10 m radius, immediately surrounding the abstraction point;

2. *respect zone:* the territory surrounding the absolute guardianship zone, to be identified in relation to local vulnerability and hazard conditions, where specific measures and restrictions must be taken into account and some activities are strictly forbidden;

3. *protection zones:* wider zones identified within the groundwater recharge areas, to ensure adequate protection of water resources.

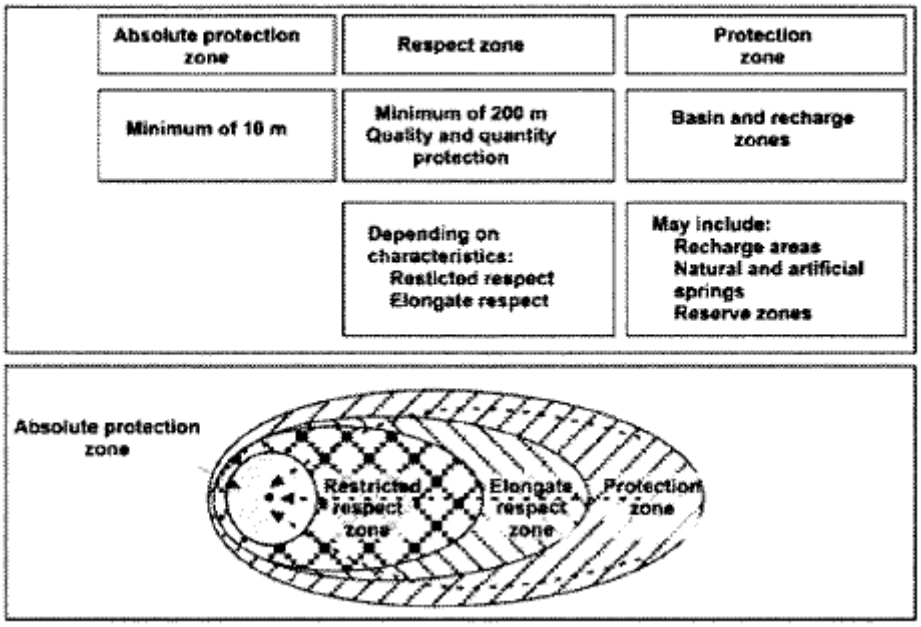

Fig. 1 – DWPAs in Italian Legislation

The *absolute guardianship zone* must be adequately protected and fenced, and only used for the installation of catchment or abstraction facilities and water service infrastructures.

In the absence of specific identification by the competent Region, the *respect zone* has a radius of 200 m from the abstraction point. It can also be divided into *Restricted respect zone* and *Elongate (or Enlarged) respect zone*, based on specific catchment condition and local vulnerability and hazard conditions. Activities such as sewage sludge and treated wastewater dispersion, chemical amendants, fertilizers or pesticides accumulation and spreading, drilling of wells for different purposes than abstracting water intended for human consumption, cattle pasture and stalling are forbidden by statal law. Regions are expected to issue regulatory acts concerning: sewage systems, housing and relating infrastructure, road works, railways and generally service infrastructure, farming practices and utilization plans content.

Protection zone delimitation is based on hydrogeological, hydrochemical and hydrological analysis. Vulnerability to pollution has also to be taken into account and specific measures such as restrictions concerning soil destination of use can be implemented and integrated in the general urbanistic and specific sectorial plans.

The Guidelines issued following the Agreement between Italian State and Regions of 12 December 2002 describes 3 different criteria for DWPAs identification and delineation:

a) *geometric:* usually adopted for the delineation of the absolute guardianship zone and the respect zone relating surface water abstraction and, only temporarily, for the delineation of the respect zone for wells and springs;

b) *temporal:* based on the concept of “safety time” (as defined in the Guidelines), it mainly applies to the final individuation and delineation of the respect zone for wells and possibly springs, taking into account specified technical elements;

c) *hydrogeological:* based on the specific hydrogeological elements characterizing the aquifer and its limits, it is usually applied to the protection zones concerning springs and the respect zones concerning wells, provided the particular complexity of local hydrogeological conditions does not allow the use of the temporal criterion (the method based on the halving time of the springs maximum annual flow rate also belongs to such criterion).

Perimeters established using the last two criteria (letters b) and c)) must be based on geological, hydrogeological, hydrological, hydro-chemical and microbiological studies, also taking into account historical data referred to qualitative and quantitative features of the investigated water resources. Such studies are designed to identify and define the limits of the areas influenced by water abstraction and must comply with the given technical guidelines.

The application of the geometric criterion for the delineation of the respect zone should have a limited duration, set by the Italian Regions, and be limited to the less important sources based on preliminary studies identifying poor urbanization of the catchment area, pending further knowledge on groundwater circulation.

Drinking Water Protected Areas (DWPAs) management is part of Water Supply Service and relating costs, in order to ensure adequate maintenance and effective monitoring activities are covered by Water Tariffs, according to Legislative Decree no. 152/2006.

Among the criteria to be considered for any revisions to the protected areas delimitation, after an assessment to be carried out every 10 years or less, if required by local conditions, the most important are:

a) new factors or changes affecting the conditions that have led the delimitation in place, with particular reference to variations of quantity of water resources abstracted or derived, relevant changes in piezometric measurements, determined by natural or antropic causes, or new technical or scientific acquisitions;

b) different destination of use assigned by the General Regulatory Plan (PRG) and Provincial Territorial Coordination Plan (PTCP) to the involved (or to be involved) areas and potential presence of hazard centers in these areas.

The delimitation of the DWPAs remain in force even if the water resources are temporarily not in use.

The individuation and implementation of buffer zones for a water resource, is a kind of so-called static protection, as the different prohibitions, restrictions and regulations applicable to these areas cannot ensure against sudden alteration phenomena and worsening of the quality of abstracted water. The activation and operation of a monitoring system capable to forecast water availability from the source, based on continuous monitoring of specific quantitative and quality parameters would instead represent a dynamic protection, so allowing you to activate with sufficient notice any intervention measures in case of contamination events by generic pollutants. The decision whether to adopt just the static protection or combine it with a dynamic protection system depends on the importance of the single water resource and is normally taken by the Region or other Competent Authority.

3 Technical elements and methodologies

3.1 Wells/Well fields protected areas

Absolute guardianship zone

According to the Legislative Decree no. 152/2006, the absolute guardianship zone of must have an extension of at least 10 m radius from the abstraction point. The geometric criterion can be applied in this case, in a functional way, thereby determining a circumference (in case of a single well) or an envelope of circumferences (in case of more wells) measured starting from the extrados of the artefacts. These areas will then be appropriately fenced and protected.

Respect zone

As already mentioned above, for the delimitation of the respect zone and particularly referring to the restricted or elongate respect zone, the temporal or hydrogeological criterion should be used depending on the more or less detailed knowledge of the local hydrogeological conditions. Through successive stages in which the static water table level and the changes induced by the water abstraction are reconstructed, the so-called isochronous lines can be traced, describing the arrival times of any pollutants in the considered flow system. A safety time of 60 days has to be considered in the individuation of the restricted respect zone, while it can be 180 or 365 days for the elongate respect zone, depending on the type of hazard and the degree of protection of the resource. In particular conditions of security the restricted respect zone can even coincide with the absolute guardianship zone.

Specific details are given relating the application of the temporal criterion and its limits, e.g. for the calculation method to be applied for tracking isochronous lines. Different types of approach to the problem are given in literature, also depending on the geometry of the aquifer (horizontal, inclined, with recharge or impermeable layer limit, etc.). Among the most widely used internationally and especially in Italy, the following three can be recalled:

- Bear abacus *(Bear, 1979)*
- Finite difference model
- Numeric codes, e.g. *"Groundwater Modeling System (GMS)"*, or *"Well Head Protection Area (WHPA)"*, released by U.S. Environmental Protection Agency.

Protection zone

The protection zone shall normally be bounded on the basis of hydrogeological, hydrochemical and hydrological studies, also taking into account the vulnerability of aquifers to pollution. This area should not be defined considering the individual abstraction point, but all the other characteristics of the aquifer, such as recharge areas, natural and man-made emergencies and reserve areas must be taken into equal consideration, in order to maintain the quantity and quality of water, also for the possibility of their future use, with particular reference to those valuable water resources, suitable for drinking use. These (re)sources and their locations should be highlighted in the Regional Water Protection Plan.

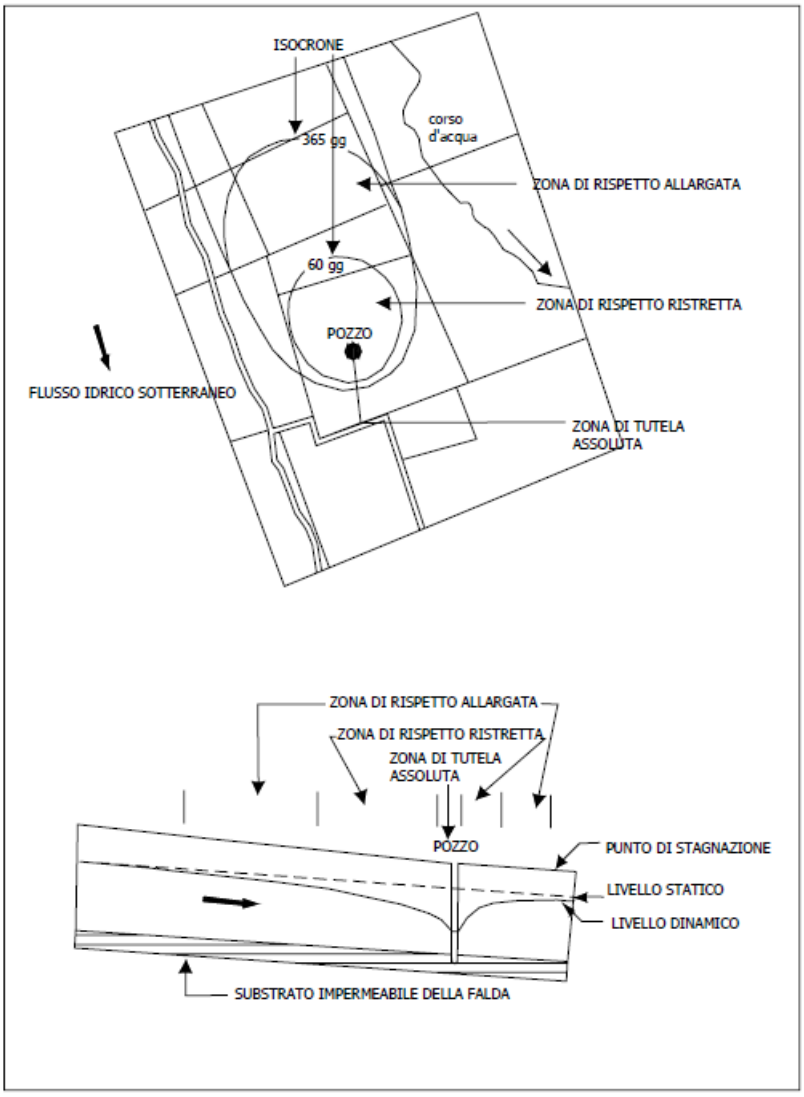

Fig. 2 – Delineation of DWPAs for a single Well, an example

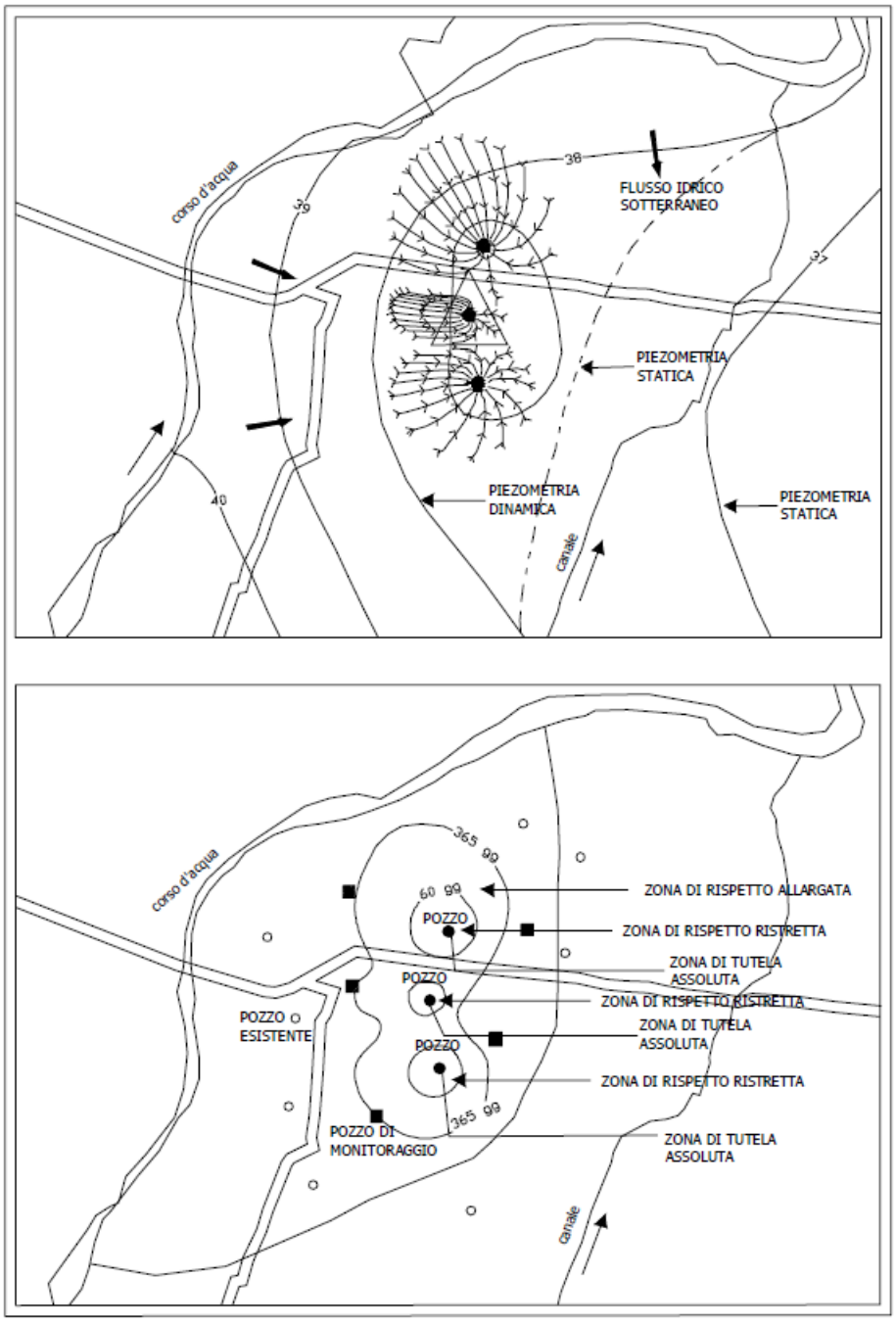

Fig. 3 – Delineation of DWPAs for a group of Wells, an example

3.2 Springs protected areas

In Italy as in many other European countries, the studies carried out for the delineation of Springs safeguard zones refer to the different kind of abstraction plants (wells, tunnels, trenches, natural caves) and to aquifers characteristics, such as porosity, fracturing, etc.

Specific methodologies for the design of protected areas especially referring to sources from fractured and karst aquifer have not been developed yet. That is probably due to the fact that in many European countries (Germany, Holland, Belgium among the largest), massive water supply from Spring is not so common, and above all to the difficulty of providing precise information on the geometry, hydrodynamic processes and parameters characterizing mountain aquifers. On the other hand a lower risk of pollution can be attributed to the same mountain aquifers compared to the alluvial ones existing in large flat areas.

Water supply for drinking purposes in Italy, however, is predominantly provided by sources located in the carbonate ridges; for this reason, the protection of these natural emergencies is undoubtedly a priority. According to the Italian legislation and the Guidelines given by the Agreement between Italian State and Regions of 12 December 2002, similarly to wells and well fields, the most important factor to be taken into account the for the delineation of DWPAs is the “time of travel”, i.e. the necessary time for the underground water flow (and therefore for a pollutant) to cover a certain distance. This time (determined by the speed of movement of a pollutant in the aquifer) is normally evaluated on the basis of reliable hydrodynamic parameters. In case these parameters cannot be determined on the basis of specific tests as permeability tests, tracer tests etc., or geological surveys (usually used only for the most important sources), they can be derived indirectly, for example using the standard source depletion / exhaustion curve.

For the calculation of the flow velocity, Civita (1988) proposes the use of the “halving time”, that is the time, expressed in days, elapsed between the occurrence of the maximum flow rate and the occurrence of a flow equal to half of this. Using data referring to numerous sources in Italy and in some countries of the Mediterranean basin, the author identifies four situations based on decreasing vulnerability (Fig. 4) based on the fact that the flow velocity is inversely proportional to the ability of self-purification of the aquifer.

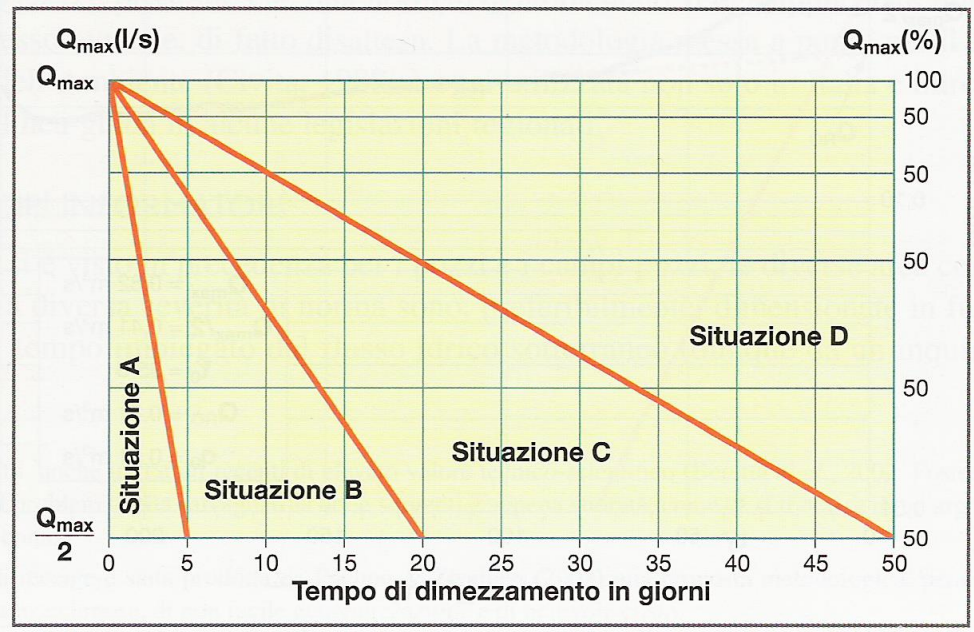

Fig. 4 – Abacus used to determine sources vulnerability, depending on halving time (Civita, 2005)

Flow velocity can be calculated by arranging daily flow rates and, in particular, those that allow to trace the initial part of the depletion curve; through the abacus of fig. 4 it is possible to determine the corresponding range of flow velocity and, consequently, propagation velocity of a pollutant (Fig. 5).

Situazione	Tempo di dimezzamento (t_D, d)	Velocità di flusso (m/s)	(m/g)
A	$t_D < 5$	$> 10^{-2}$	> 1000
B	$5 \leq t_D \leq 20$	10^{-2} - 10^{-3}	≈ 100
C	$20 \leq t_D \leq 50$	10^{-3} - 10^{-4}	≈ 10
D	$t_D > 50$	10^{-4} - 10^{-5}	≈ 1

Fig. 5 – Flow velocity estimation, based on halving time (by Civita, 2005, modified)

Absolute guardianship zone

The delimitation of springs absolute guardianship zones must take into account the different type of uptake (vertical wells and drains in porous or fractured aquifers, drainage tunnels or trenches, direct uptake in underground cavity or cave), as well as aquifer (natural) protection and pollution risk.

The absolute guardianship zone should be possibly fenced and adequately protected from possible disruptions or landslides, intense erosion other phenomena and floods. Italian legislation does not indicate a unique methodology to be followed for the sizing of the area, which should still have an extension not less than 10m radius. Among the methods available in the literature, the one proposed by Civita (1988 and 2005), developed from the work of Georgescu (1965), undoubtedly appears the most flexible and easy to apply.

Dimensions relating the absolute guardianship zone are calculated based on the abacus and the table given above (Fig. 4 and Fig. 5) also depending on the type of water uptake (from spring, from aquifer, direct from underground cavity).

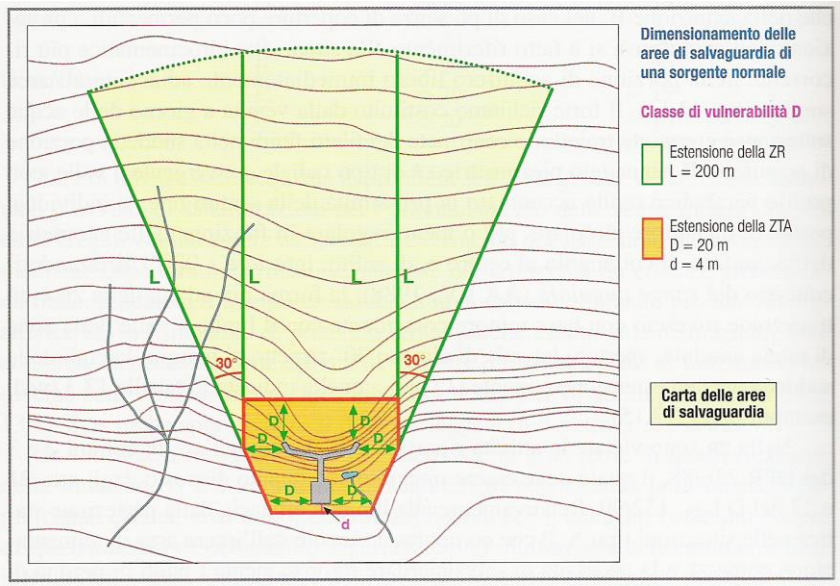

Fig. 6 – Example of sizing of safeguard zones for a water source (uptake from aquifer) based on local specific vulnerability conditions (by Civita, 1988, 2005).

Respect zone

With regard to the respect zone, the guidelines provide three different situations:

- if the *geometric criterion* is adopted, the respect zone should correspond to a portion of a circle with a radius of at least 200 m, centered on the abstraction point, which extends upstream of the intake and it is bounded downstream by the contour line passing through the uptake; when the hydrodynamic conditions of the aquifer require so, the respect zone can be extended also downstream of the intake for an extension appropriate to the specific situation.

- if the *hydrogeological criterion* is used, it must be based on studies carried out also by mean of hydrochemical techniques (hydrochemical facies, use of tracers and environmental isotopes). Among the various applicable methods the one based on the halving time of maximum annual flow rate can also be used. The applicability of this method must be checked case by case based on the specific hydrogeological conditions: it requires the availability of reliable series of flow rate measurements to determine the depletion curve of the springs.

- in case of use of the *time criterion*, a safety time of 60 days is normally used referring to the restricted protection zone, while it is usually 180 or 365 days for the enlarged protection zone, depending on vulnerability and hazard conditions.

As for the absolute guardianship zone, even in this case, in the absence of specific data obtained with permeability tests or, better, using isotopic and environmental tracers, it is possible to use tables derived from the same abacus shown in Fig. 4.

Protection zone

The sizing of the protection zone of a spring should be based on hydrogeological, hydrochemical and hydrological studies referring to the feeding aquifer structure. As a precautionary measure, it seems appropriate to include in the protection zone the entire feeding area of the source, including any surrounding aquifer structures, from which a significant groundwater inflow phenomenon is active. Different boundaries (narrower) should result from detailed studies or monitoring activity referring to both qualitative and quantitative analysis on water precipitation, surface runoff and groundwater circulation. For sources fed by very large structures, it is expected that the severity of the constraints is put in relation to the importance of the supply and the presence of critical elements in terms of protection of the water resource. Availability of Vulnerability maps is to be considered indispensable for the purpose of a global view of the issues linked to aquifer pollution risks.

3.3 Surface water protected areas

Legislative provisions relating protected areas (and their methods of delimitation) in the case of surface water are far less detailed than those for groundwater. This fact is probably justified by a general lower use of this kind of resources compared to the more common supply from wells and springs. The criteria set out by law provide that the studies should be carried out for as an extended area as to be consistent with the purpose of the maintenance of water quality, also considering the ratio between the abstracted water and the volume or flow rate of the involved surface water body.

Whenever possible, the intake facility should be located and constructed in such a way as to prevent from pollutants inflow, also taking into account various factors related to the type of streams and, particularly referring to lakes and reservoirs, to thermal stratification phenomena of water masses. For the existing intake facilities and in case this is not possible, adequate precautionary measures must be taken.

With regard to protected areas, they are differentiated into two categories: those relating to natural waterways and channels, and those relating to lakes, natural or artificial reservoirs.

3.3.1 Natural waterways and channels

Absolute guardianship zone

The absolute guardianship zone, in accordance with Art. 94 of the Legislative Decree no. 152/2006 must have an extension, wherever possible, of at least 10 meters radius and must be adequately protected for an area including the artifacts relevant for water abstraction. It only has the function of protection of the water abstraction facility.

Respect zone

The respect zone develops upstream of the intake interesting the waterway and its banks. The longitudinal extension, where possible not less than 200 m, must be related to various factors including, in particular, the water derivation flow rate, the speed and the flow rate of the water body. The lateral width of the area (measured from the river central line) is calculated based on the risk of pollution resulting from the destination of use of the surrounding area.

Protection zone

The protection zone, aimed at maintaining and improving the quality characteristics of the water bodies upstream of the supply intake, must be dimensioned taking into consideration the hydrogeological characteristics of the catchment area and surface water bodies, as well as the importance of the water supply.

3.3.2 Lakes, natural and artificial reservoirs

Absolute guardianship zone and respect zone

Given the peculiar characteristics of the considered water bodies, the absolute guardianship zone and the respect zone, normally coincide. The legislation in force provides that this area should comprehend, where possible, a portion of the lake bounded by a circle with radius of at least 200 m with the center in the abstraction point and shall extend towards the nearest coastline, involving a length not lower than that between the extreme points of the projection of the diameter on the same coastline.

Protection zone

The protection zone concerning water abstraction from natural and artificial lakes and reservoirs is aimed to maintenance and improvement of the characteristics of water quality in water bodies of the catchment area upstream the supply intake, also referring to the provisions of the Water Protection Plans.

For the protection zone, the considerations made for the waterways remain valid. In the protection zones of water resources feeding reservoirs used for drinking purposes, there should be restrictions to the expansion of urban centers, the discharge of waste water, the installation of hazardous industries, to livestock raising, intensive agricultural activities, to the opening of quarries, to cultural practices that promote erosion and slope instability and to any other destination of use of the territory that may compromise the status of the resource used.

4 Conclusions

WFD establishes a general framework for delineation of the source protection areas. A wide diversity of strategies and methods for their implementation across the different countries of the European Union makes it convenient to develop some summarizing guidelines which should be considered as an orientation for this implementation.

According to Italian legislation in force, Legislative Decree no. 152/2006, deriving from WFD (Directive 2000/60/CE), safeguard zones are to be defined based on hydrogeological, hydrochemical and hydrological analysis. Vulnerability to pollution is also taken into account.

Guidelines issued following the Agreement between Italian State and Regions of 12 December 2002 describes 3 different criteria for DWPAs identification and delineation (geometric, hydrogeological, temporal), also giving technical elements and specific methodologies for each kind of water source (wells, springs, surface water).

Currently the "absolute guardianship zone" and the "respect zone" have already been delineated in most cases, while Regions are establishing protected areas. In few cases protected areas have been already identified and protection measures are in force.

A wide diversity of strategies and methods for their implementation across the different countries of the European Union makes it convenient to develop some summarizing guidelines which should be considered as an orientation for this implementation.

These guidelines should consider, in a flexible way, all different potential problems that may occur in order to get the target objective that would be to collaborate in increasing the efficiency and accuracy of surface water and groundwater intended for human consumption.

5 References

[1] Directive 2000/60/EC of the European Parliament and of the Council, of 23 October 2000, establishing a framework for Community action in the field of water policy (Water Framework Directive, WFD);

[2] Italian Legislative Decree no. 152, of 3 April 2006, concerning *"Norme in Materia Ambientale"*, published in *"Supplemento Ordinario alla Gazzetta Ufficiale della Repubblica Italiana, n. 88 del 14 Aprile 2001"* and further modifications, (Italian "Environmental Code");

[3] *"Protection of Groundwater intended for Human Consuption in the Water Framework Directive: Strategies and Regulations applied in some European Countries"*, Álvaro García-García, Carlos Martínez-Navarrette – Polish Geological Institute Special Papers, 18 (2005): 28-32. Proceedings of the Conference "Hydrogeological transboundary problems. West and East European Bridge";

[4] "Linee guida per la tutela della qualità delle acque destinate al consumo umano e criteri generali per l'individuazione dellearee di salvaguardia delle risorse idriche di cui all'articolo 21 del decreto legislativo 11 maggio 1999, n. 152" (Guidelines concerning DWPAs individuation, following the Agreement between Italian State and Regions, of 12 December 2002);

[5] "Studio della disponibilità attuale e futura della risorsa idrica nell'A.A.T.O. N.3 Marche - Centro e linee guida per l'individuazione delle aree di salvaguardia delle risorse idriche" (Study concerning present and prospective availability of water resources and guidelines for the individuation of safeguard zones" – Earth Science Department, University of Camerino (2005).

Italian legislation on DWPAs – Macerata 15.06.2015

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Slovenian Rules on criteria for the designation of a water protection zone

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(FB5)

Ljubljana, 2015

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Table of content

1 Introduction

Slovenian legislation dealing with water protection zones is presented the following regulation that was the source for preparing this report:

Rules on criteria for the designation of a water protection zone (Official gazette of republic of Slovenia No. 64/04, 5/06 in 58/11), *original title: Pravilnik o kriterijih za določitev vodovarstvenega območja*. In the following chapters a summary of this regulation is presented.

Besides, some researchers deal with the implementation of the Rules and the proper approach to delineation of drinking water protection zones (Prestor et al. 2008; Brenčič et al., 2009).

2 Content of the Rules

Relating to water bodies or parts thereof (hereinafter referred to as the body of water) that is used or intended for the abstraction of water these Rules provide:

- criteria for determining the external and internal boundaries of water protection areas,

- criteria for determining water protection regime in relation to interventions in the environment, which can pose risk of pollution of the water body, and

- other issues necessary to determine the water protection area.

The provisions of these Rules shall apply for the protection of water bodies, which are used or intended for the abstraction of water for:

- public drinking water supply,

- human consumption, in the case of mineral and thermo-mineral water, and

- manufacture of beverages.

3 Starting point for delineation of protection areas

Starting point for delineation of protection areas is based on:

1. natural features of the water body and its recharge zones that protect water bodies from pollution or other types of pollution,
2. long-term significance of the water body for local and regional development,
3. conditions of the provision of drinking water and the requirements of regulations governing drinking water,

4. estimates of actual and potential pathways of microorganisms along the flow of water to capture,
5. estimates of actual and potential pathways of chemical and physical pollutants downstream of surface water and groundwater to capture,
6. risk of pollution due to environmental interventions (Annex 1), and
7. costs for the establishment of water protection regime and the costs for setting up the technology of preparation and purification of water taken from the body of water that is protected by water protection regime.

In determining the risk of pollution it is necessary to consider the type of intervention in the environment and the associated adequacy of the envisaged technologies, microbiological, chemical and physical properties of pollutants that could endanger the body of water, and natural features of the recharge area of capture.

Water protection area must be defined so that it is possible to implement water protection regime to the extent and in a manner which ensures the preservation of the natural state of the water body.

Irrespective of this, in case if water protection area in an area that is already at risk, water protection areas should be defined in a such way that it is possible to implement water protection regime at least to the extent and in a manner which ensures reduction in the risk of pollution due to human intervention in the environment from Annex 1 to a level that is acceptable for the abstraction of water.

3.1 Capture area (abstraction zone)

- The capture area is the enclosed (fenced) area of water adjacent to the capture.
- The capture area should provide protection of the water capture against direct damage of capture facilities and direct entry of pollutants into the capture, or its proximity.
- In the capture area only the maintenance and renovation of facilities that serve the capture are allowed.

3.2.1 Determination of the border of capture area

(1) The boundary of the capture area is generally around 10 m and/or upstream of the well or drainage.
(2) The boundary of the capture is generally 20 m around the capture of karst spring.
(3) The boundary of the capture is generally at least 20 m around the capture on surface water body, with fenced borders on land and floats for border on water.
(4) The boundary of the capture is generally at least 20 m around the capture, if it is in the riverbed of surface water, while the border with floats need not be marked if the hydraulic conditions do not allow this, but at the capture boards have to be placed, which prohibit approach and have to be legible from a distance 50 m.
(5) If the capture is on the river bank of the flowing surface water and the width of the channel at low water conditions is less than 20 m, the area of the capture has to include the 10 m belt on the opposite bank of the capture.

(6) The capture area also includes drainage legs, drainage channels, galleries and fissures that have a direct connection with the capture.

3.2 Protection areas

Water protection area can be divided due to the different levels of protection, namely:

1. outer area with the moderate protection regime (III),

2. middle area with the rigorous (strict) protection of the water protection regime (II),

3. inner area with the most rigorous protection regime (I).

- Outer water protection area covers the whole catchment area of the capture (spring/well) and is intended for the provision of long-term drinking water health. In this area the water regime is in order to ensure an acceptable risk for pollution of the water body with radioactive materials or substances, which are persistent, or decompose very slowly.

- Middle water protection area is the area which, according to natural conditions, provides a sufficiently long residence time, sufficient dilution and sufficient time for water filtration action. In this area the water regime is to ensure an acceptable risk for pollutant of the water body with pollutants, which slowly diminish.

- Inner water protection area is the closest to the capture, where, according to the natural conditions, dilution of pollutants is small and pollutants quickly arrive to the capture. In this area the water regime has to ensure an acceptable risk for pollution of water body with micro-organisms and other pollutants.

If the analysis of the risk of pollution already implemented environmental interventions in the water protection zone follows that water protection regime in relation to new interventions in the environment provides an acceptable risk of pollution of the water body only in one part of inner area, the area must be split into two or more smaller sub-areas, which apply water protection regimes of different complexity.

3.2.2 Water protection regimes

The water protection regime is provided in the form of prohibitions, restrictions and protection measures for interventions in the environment, which are listed in Annex 1. In inner water protection areas all interventions marked with »-« are prohibited. Interventions marked with »pp« and »pip« are also prohibited, if the risk analysis was not performed, or the risk analysis results have shown that risk for water pollution is not acceptable.

In case of »pip« the intervention has to be included in the state or municipal spatial plan. The Spatial plan has to be verified by environmental report and the assessment of the effects on the environment. Impacts of the intervention on water regime and status and the design of protection measures has to be verified by risk analysis in the Spatial plan enacting procedure.

In case of »pp« design of protection measures of the intervention has to be verified by risk analysis. Impacts on water regime and status have to be verified in the construction permitting procedure.

Mark »pd« means that impacts of the intervention on water regime and status have to be verified in the building permitting procedure.

In water protection areas all interventions marked with »+« are allowed.

3.2.3 Criteria for determination of the size of protection areas

(1) The size of the protection areas is determined according to the type of surface- or ground-water body and characteristics and their recharge area and on the basis of residence (retention) time of pollutants, dilution of pollutants from the site of input to the capture or the time for action.

(2) Residence time and dilution of pollutant from the input point to the capture depends on the water velocity through the aquifer, which is determined on the basis of water inflow time estimates from any point in the recharge area to the point of capture.

(3) Time of the water inflow shall be calculated on the basis of measurements and model calculations. Time is the sum of the inflow of pollutants to the capture from the input point to the groundwater flow (travel time through the unsaturated zone) and the flow of pollutants within the groundwater (travel time in the saturated zone).

(4) The time for action is determined on the basis of estimates of time of implementation of possible intervention measures and the measures dealing with the effects of pollution before the pollutants arrive to the capture.

3.2.4 Determination of the size of protection areas

The size of the water protection area shall not be less than the natural recharge zone, which is calculated as follows:

$P\ [m^2] = Q_0 / Q_{recharge}$,

where:

- $Q_{recharge}$ [m/s] is the amount of recharge of the water body by precipitation, from surface water and from groundwater inflows. All forms of recharge of the water body are expressed as equivalent quantity of precipitation (m^3) in a unit area (m^2) per unit time (s).

- Q_0 is the average flow of water abstraction [m^3/s].

Surface water protection area of groundwater capture in springs is calculated that the average flow of water abstraction takes into account the average daily discharge.

In calculations of the amount of recharge of water body that is used for the water abstraction also following quantities should be considered: the amount of water inflow from

the river bed, from tributaries, from the inflows from other aquifers, and the quantities of not captured outflows out of water protection area.

The protection zones should also cover areas outside the boundaries of the recharge area, in case the risk of pollution of the water body or the likelihood of changes in quantitative status or direction of water flow outside the borders of the recharge zone is not negligible.

4. KARST AQUIFERS

4.1 Water protection areas determination for karst aquifers

For determination of water protection areas for the protection of the water body within the karst aquifer, it should be noted that:

(i) The groundwater flow has characteristics of turbulent flow through the channel and cannot be described by calculations based on the Darcy equation and it is therefore not possible to draw groundwater contours and determine isochrones (lines with the same travel time);

(ii) The groundwater generally flows with velocities that are significantly greater than 10 m per day, and are strongly dependent on hydro-meteorological conditions;

(iii) The distribution of groundwater velocities is very heterogeneous and therefore the risk of pollution does not decrease with distance from the capture;

(iv) The retention and filtering capacity of the aquifer may be poor, in the open karstified areas these capacities are negligible;

(v) The microorganisms traveling through the porous media under most conditions cannot be degraded.

The water protection area of karst aquifers is determined according to the intervention time and, if possible, also with regard to the retention time of pollutants and dilution of the pollutants.
In addition to the above mentioned criteria it should be noted that for the water capture in the karst aquifer:

(i) Within the Outer water protection area capture has to be protected with a sufficiently long retention time of pollutant in the covering layers or the unsaturated zone of the aquifer, or with sufficient dilution of pollutant, so that the implementation of intervention measures and elimination of pollution in the capture is possible.

(ii) Within the Middle water protection area the capture has to be protected with the implementation of intervention measures in a very short time, since the pollution in this area has rapid and strong impact on the capture due to the possible penetration of

pollutants through the karstified areas to groundwater or to the groundwater in karst channels, the implementation time for exacting intervention measures is very short.

(iii) Within the Inner water protection area protection of the capture has to be ensured from any pollution, because the pollution in this area has fatal consequences for capture due to potential infiltration of pollutants through karstified areas into the groundwater system, or the groundwater flows in karst channels, therefore, the implementation of intervention measures in this area is impossible.

4.2 Border of water protection area for karst aquifer

The border of **the water protection zone for a karst aquifer** (Figure 1) is equal to:

1. for the Outer area (III): the external border of catchment area,

2. the Middle area (II): the border of karstified area from where the travel time to the capture is more than 12 hours, and

3. the Inner area (I): the border of karstified area from where the travel time to the capture is less than 12 hours.

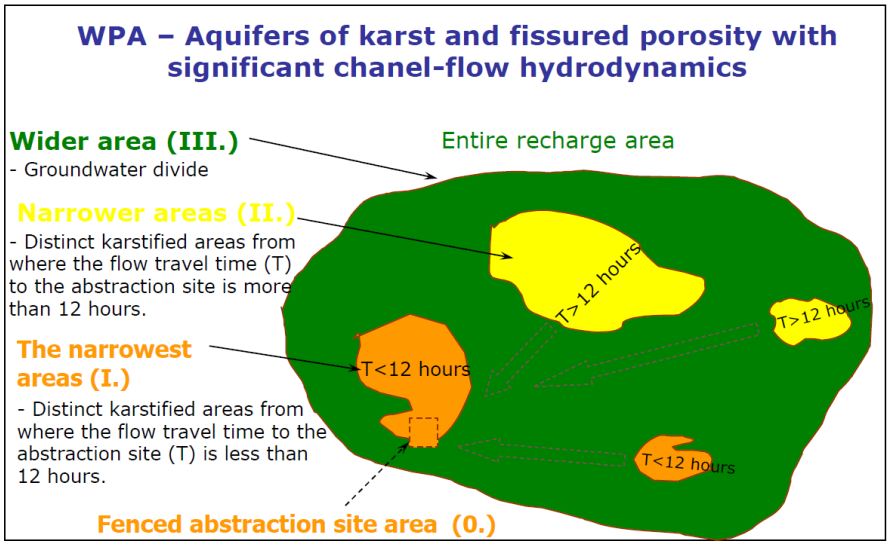

Figure 1: Water protection zones for karst aquifers (Prestor et al, 2008)

The border of the **Outer protection area (III) of karst aquifer** is equal to the outer border of the total natural recharge area (catchment zone).

The border of the **Middle protection area (II) of karst aquifer** is determined by: (i) fractured areas with high flow velocities, together with the main and tributary flows to the capture,

(ii) swallow hole areas including areas of potential surface runoff in the swallow hole area with a direct link to the groundwater level,
(iii) areas of karst poljes (including areas of potential surface runoff into the swallow hole area with a direct link to the groundwater level.

Notwithstanding the provisions of the preceding paragraph, it is necessary to add karstified areas where they are covered with very low permeable and continuous geological layers with thickness of at least 8 m, or if the covering layers contain a perched/aquifer, or where groundwater is separated from the aquifer by a very low permeable layer with a thickness of at least 5 m.

The border of **Inner protection area (I) of a karst aquifer** is determined by:
(i) karstified and fractured areas with a direct link to the capture or pumping station,
(ii) fractured areas with high flow velocities, together with the main and tributary flows to the capture or pumping station,
(iii) swallow hole areas including areas of potential surface runoff into the swallow hole area with a direct link to the groundwater level,
(iv) areas of all karst poljes including areas of potential surface runoff on the poljes with swallow holes, which have direct link to the groundwater level.

4.3. The basis for determining the borders of water protection areas for karst aquifer

(1) The boundaries of protection areas for the karst aquifer are determined on the basis of:

- groundwater flow velocities,
- the direction of groundwater flow,
- groundwater levels,
- dilution of actual and potential pollutants,
- the size of the catchment area,
- karstification rate of the recharge/catchment area, and
- geochemical properties of groundwater.

(2) The information referred to in the preceding paragraph shall be obtained by using the following methods:

- determination of the surface recharge/catchment area according to surface morphology and the river network,
- estimation of geo-hydraulic properties of the water flow through the geological layers,
- determination of hydrogeological boundaries on the basis of stratigraphical, lithological and structural (tectonic) elements acquired by the field mapping and photogrammetric geological surveys,
- catchment area assessment to identify the origin of groundwater on the basis of assessment of hydro-geochemical units/ determination of catchment area after

identifying the origin of groundwater on the basis of assessment of hydro-geochemical units,
- determination of karstified areas with speleology research, or
- tracer experiments by determining the groundwater flow velocities, dilution and dispersion parameters of pollutants.

(3) If the application of the results of only one of the methods described in the preceding paragraph does not provide reliable and efficient determination of borders, a combination of methodologies should be used to determine the border of water protection area.

5. POROUS (INTERGRANULAR) AQUIFERS

5.1 Water protection areas determination for porous aquifers

For determination of areas for the protection of the water body within the porous aquifer, the groundwater flow characteristics should be described by calculations based on the Darcy equation ($Q = k \times i \times A$), from which a piezometric map and isochrones (lines with the same travel time) should be determined, considering:

(i) The groundwater flow velocities in the porous aquifer are generally lower than 10 m per day and do not significantly depend on the hydrometeorological conditions; distribution of velocities is generally homogenous;

(ii) The risk of groundwater pollution usually decreases with the distance from the capture, the microorganisms traveling through the porous media are mostly removed.

The inner zone of porous aquifers is determined according to the retention time of pollutants and their dilution.

5.2 Border of water protection area for porous aquifer

The border of the **protection area for a porous aquifer** (Figure 2) is equal to:

(ii) for the Outer area (III): the border of catchment area,

(ii) for the Middle area (II): the minimum of the 400-day isochrone, calculated for the travel time to the capture through saturated zone, and

(iii) for the Inner area (I): the minimum of the 50-day isochrone, calculated for the travel time to the capture through saturated zone or circular line in the distance at least 50 m from the capture, if it is longer.

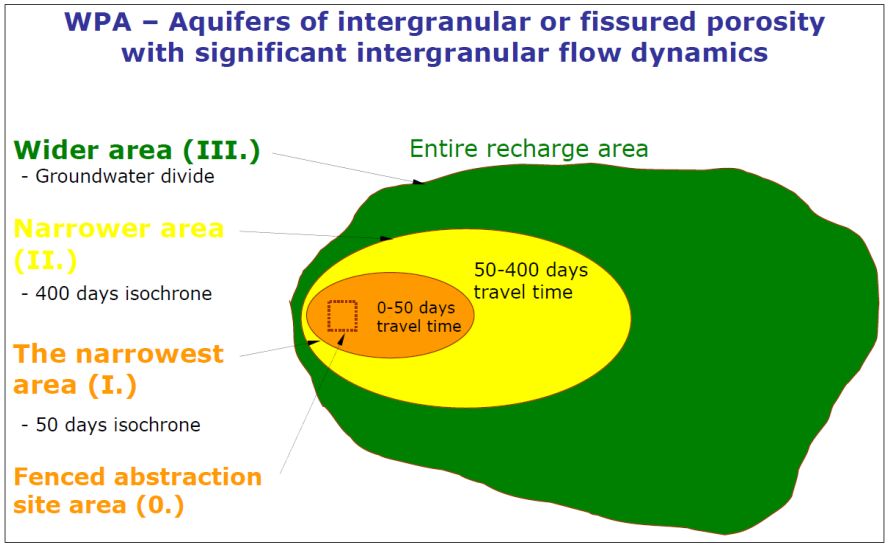

Figure 2: Water protection zones for porous aquifers (Prestor et al., 2008)

5.2.1 External border of the water protection area for porous aquifer

(i) Irrespective of the provision 5.2, the border of the Outer area must be on the border of the depression funnel and on the external lateral current line downstream to the border of the catchment area.

(ii) In definition of the border of the Outer area from previous paragraph has to take into account also dispersion.

5.2.2 Border of the Middle area (II) for porous aquifer

(i) The surface of the Middle area cannot be smaller than the part of the capture catchment area, which provides long-term recovery of the quarter of the abstracted water volume during the average hydrological year.

(ii) The border of the Middle area can be closer to the capture in the case of an aquifer covered with continuous layers of very low permeability with thickness of at least 5 m or at least 8 m if the flow velocity is higher than 10 m/day. In this case, the border of the Middle area should be at least in a distance of 1000 m from the capture or at the 50-day isochrone.

(iii) The border of the Middle area can be closer than 50-day isochrone to the capture, if the results of the groundwater pollution risk analysis taking in the account protective measures (in accordance with the criteria for the size of protection areas mentioned in the beginning of this report) ensure that the interventions in the water protected area do not represent a risk to the water body.

5.2.3 Border of the Inner area (I) for porous aquifer

(i) The border of the Inner area is equal to the 50-day isochrone calculated for the water flow to the capture below the groundwater level through the saturated zone.

(ii) Notwithstanding the provisions above, the border of the Inner area should not be closer than a circular line around the capture with the radius of 50 m.

5.2.4 Exceptions in determining the border of the protection area for porous aquifer

(1) Notwithstanding the provisions above, the protection area is not determined if:

(i) the groundwater is taken exclusively from deep aquifers which are not supplied directly from the surface,

(ii) aquifers are covered with layers with very low permeability,

(iii) the wells for water abstraction from deep aquifers have properly sealed part above the captured layer, and

(iv) all water is protected with layers of very low permeability and appropriate thickness between the well and border, which is equal to 50-day isochrone.

(2) Enforcement of the provisions of the preceding paragraph should be justified and evidenced in the geological analysis made in accordance with the provisions of the “Planning of protection measures” (this regulation).

5.3 The basis for determination of the boundaries of protection areas

(1) The boundaries of protection areas for the porous aquifer are determined on the basis of:

- groundwater flow velocities,
- the direction of groundwater flow,
- groundwater levels,
- dilution of actual and potential pollutants,
- the size of the catchment area, and
- geochemical properties of groundwater.

(2) The information referred to in the preceding paragraph shall be obtained by using the following methods:

- determination of the surface recharge area according to surface morphology of the river basin,
- estimation of geo-hydraulic properties of the water flow through the geological layers,

- determination of hydrogeological boundaries on the basis of stratigraphical, lithological and structural (tectonic) elements acquired by the field mapping and photogrammetric geological surveys,
- determination of catchment area after identifying the origin of groundwater on the basis of assessment of hydro-geochemical units,
- tracer experiments by determining the groundwater flow velocities, dilution and dispersion parameters of pollutants,
- graphic design of external streamlines and isochrones by modelling characteristic external boundary streamlines - the lower culminated points and the theoretical width of the capture, or
- external streamlines planning and planning of isochrones with mathematical modelling.

(3) If the application of the results of only one of the methods described in the preceding paragraph does not provide reliable and efficient determination of borders of inner areas, a combination of more methodologies should be used to determine the border of the inner areas of water protection area**.**

5.4 Safety extension of the boundary of water protected zone for porous aquifer

Water protected area has to be extended in the lateral and longitudinal direction if the intensive study of hydrogeological conditions reflects that:

(i) a part of groundwater runoff from the natural catchment area passes by the depression funnel,

(ii) a part of groundwater runoff from the natural catchment area passes by the capture,

(iii) the gradient of piezometric level changes in various hydrological periods,

(iv) the aquifer transmissivity changes during low groundwater level in dry seasons,

(v) groundwater flow direction changes,

(vi) the aquifer is not homogeneous,

(vii) water flows to the capture from several aquifers, which are situated one over the other, or

(viii) no information is available about the dispersion or they are unreliable.

6. FISSURED AQUIFERS

6.1 Water protection areas determination for fissured aquifers

For determination of protection areas for fissured aquifer, it should be noted that:

(i) The groundwater flow may have similar characteristics as the water flow in porous or karstic aquifer;

(ii) The characteristics of this aquifer are more similar to those of the porous aquifer, if the flow of water through the cracked middle homogeneous is laminar;

(iiI) The characteristics of this aquifer are more similar to those of the karst aquifer, if the water flow is not laminar or if it is running through the middle, which is inhomogeneous cracked.

Inner areas of fissured aquifer are defined according to the characteristics of groundwater flow in a way that is used to define the inner areas of porous or karst aquifer.

7. SURFACE WATERS

Water protection areas depending on the type of surface water bodies for the withdrawal of water are determined in a special way for the **stagnant (still) and flowing water**.

The border of **water protection zone of surface water capture** is determined by the method:

- selected distances,
- isochrones and dilution of pollutants, or
- intervention time.

7.1 Stagnant (still) surface water

For determination of the protection areas for security of stagnant surface water should be noted that:

(i) These waters characterize slow water flow, because on the flow of water surface gradient of the water has no influence;

(ii) The bodies of stagnant surface water have typical average residence time longer than 5 days;

(iii) Quantitative, chemical and ecological status of surface water bodies is heavily dependent on seasonal changes in the hydrometeorological conditions.

7.1.1 Surface water protection zones for the abstraction of stagnant surface water

(1) The border of water protection zones for the abstraction of stagnant surface water (Fig. 3) is determined using the method of selected distance as:

- the Outer area includes the catchment area of the water source,
- the Middle area comprises all flowing waters including riparian zone up to 100 m,
- the Inner area comprises standing water including 100 m of riparian zone at the maximum 100-year water level, and
- the Middle zone extends at least 100 m outside the Inner area.

(2) The border of water protection zones for the abstraction of stagnant surface water using the method of isochrones having regard to the annual high-water is determined by:

- the Outer area includes the catchment area of the water source,
- the Middle area comprises the whole stagnant water, its riparian zone at least 100 m wide, and flowing water, where the flow time until the capture is less or equal to 20 days, including their 100 m riparian zone,
- the Inner area includes the part of the stagnant and flowing waters, where the flow time to capture is less or equal to 10 days, including their 100 m riparian zone at the maximum 100-year water level of standing water and a one-year water level for flowing water,
- the Middle zone extends at least 100 meters outside the Inner area.

(3) The border of a water protection area for the abstraction of stagnant surface water is determined using the intervention time method with calculating the flow rate of water in a one-year high flow and considering the provisions of inner areas of these Rules:

- the Outer area includes the catchment area of the water source,
- the Middle area includes the part of the stagnant and flowing water, where the flow time to capture is less or equal to 48 hours, including the 100 m riparian zone at the maximum 100-year water level of stagnant water and one-year water level for flowing water,
- the Inner area includes the part of the stagnant and flowing water, where the flow time to capture is less or equal to 12 hours, including the 100 m riparian zone at the maximum 100-year water level of stagnant water and a one-year water level for flowing water, and
- the Middle zone extends at least 100 meters outside the Inner area.

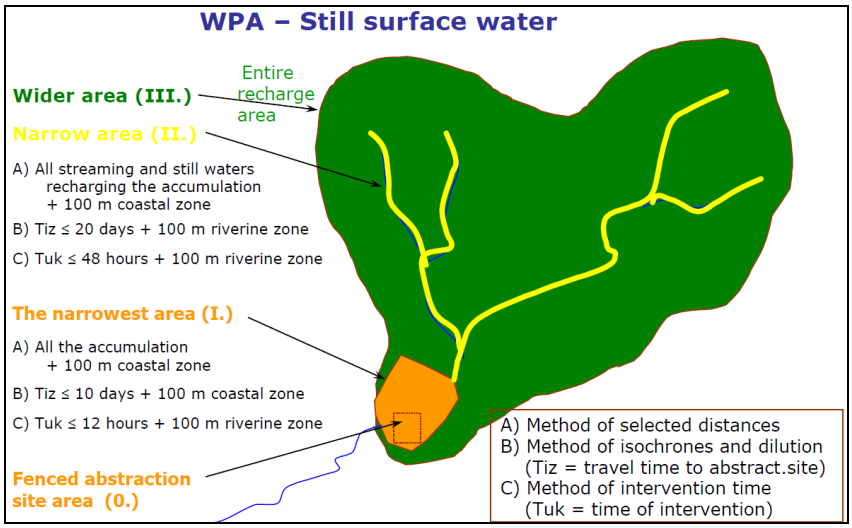

Figure 3: Water protection zones for stangnant surface water (Prestor et al., 2008)

7.2 Flowing (streaming) surface water

For determination of the protection areas in case of abstraction of flowing surface water bodies should be noted that:

(i) For these waters the longitudinal velocity component is expressed due to the gradient of water levels and on the basis of this velocity isochrones are calculated;

(ii) Quantitative, chemical and ecological status of surface flowing water depends heavily on seasonal changes in the hydrometeorological conditions.

7.2.1 Surface water protection zones for the abstraction of stagnant surface water

(1) The border of water protection zones for the abstraction of flowing surface water (Fig. 4) is determined using the method of selected distance as:

- the Outer area includes the catchment area of the water source,
- the Middle area includes all flowing and stagnant water from which part of the stream with the capture is recharged, including their 100 m riparian zone,
- the Inner area comprises a part of the stream with the capture towards the 15,000 m upstream and 50 m downstream, including the related 100 m riparian zone of the stream at the maximum 100-year return period water level, and
- the Middle zone extends at least 100 meters outside the Inner area.

(2) The border of water protection zones for the abstraction of flowing surface water using the method of isochrones having regard to the annual high-water is determined by:

- the Outer area includes the catchment area of the water source,

- the Middle area comprises a network of surface water flows, for which the flow time to capture is less or equal to 5 days, including 100 m riparian zone,
- the Inner area comprises a part of the stream with the capture, for which upstream flow time to capture is less or equal to 1 day, including their 100 m riparian zone at the maximum 100-year water level, and
- the Middle zone extends at least 100 meters outside the Inner area.

(3) The border of a water protection area for the abstraction of flowing surface water is determined using the intervention time method with calculating the flow rate of water in a one-year high flow and considering the provisions of inner areas of these Rules:

- the Outer area includes the catchment area of the water source,
- the Middle area includes the part of the network of surface water, for which the flow time to capture is less or equal to 12 hours, including the 100 m riparian zone,
- the Inner area comprises a part of the stream with the capture, for which the flow time to the capture is less or equal to 4 hours, but not less than 500 m, including their 100m riparian zone at the maximum 100-year return period water level, and
- the Middle zone extends at least 100 meters outside the Inner area.

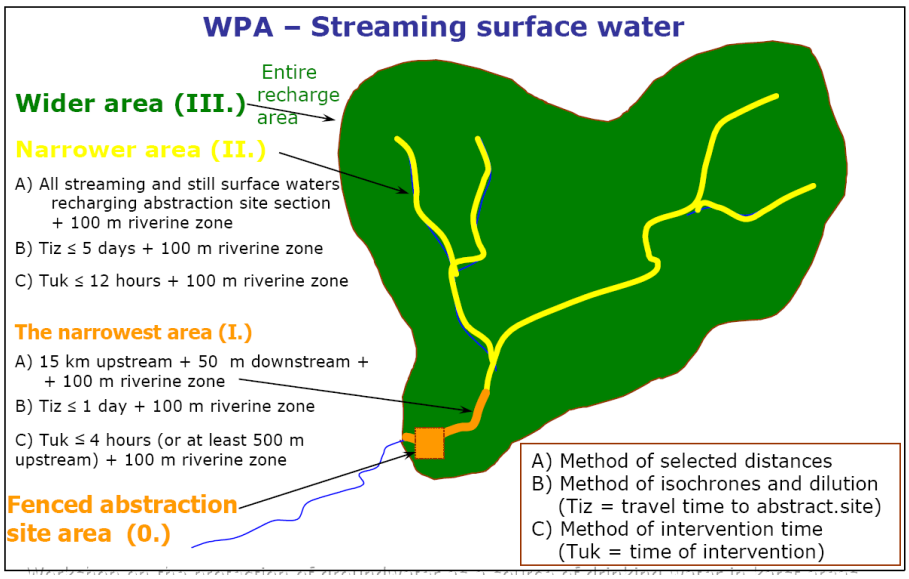

Figure 4: Water protection zones for flowing surface water (Prestor et al., 2008)

7.3 Protection zones of “special” captures

7.3.1 Systems of different aquifers

(1) If the water flows into the capture from several aquifers, which lie one above the other, it is necessary to assess the quantities of contributing water of individual aquifers by abstraction.

(2) The borders of water protection areas of aquifers, which lie one above the other, must be adapted to capture aquifer, which has the largest catchment area.

7.3.2 Groundwater recharge from surface water

(1) If the water in the capture consists of water from the riparian part of surface water and water from the aquifer, both criteria for determining the boundaries of water protection areas for groundwater and surface water are used.

(2) Water, which naturally recharges the aquifer, must not exceed the quality limits prescribed by the regulations governing the quality of surface water intended for the abstraction of drinking water.

(3) In case that surface water is part of the renewal of groundwater and if the majority of surface water runoff infiltrates into the exploited aquifer, the catchment area of surface water must be included at least in the Outer area.

(4) For the capture of which, due to morphological or geological conditions, water is abstracted after the infiltration from the surface through the aquifer in time that is shorter than 50 days, it is necessary to determine whether the protection measures in the Inner area are sufficient the protection of capture.

7.3.3 Artificial recharge of the aquifer

(1) Water that artificially recharges the aquifer must not exceed the limits prescribed by the regulations governing the quality of surface water intended for the abstraction of drinking water.

(2) The area between the location of artificial recharge and catchment area must be classified in the Inner area where the flow time from recharge area to capture during the intensive supply is less than 50 days.

(3) The facilities of artificial recharge should be the subject to the same water protection regime as the catchment facilities (capture).

(4) The whole area should be fenced in case:

- if the distance between the location of artificial recharge and the capture is less than 50 m

- the aquifer is not covered with continuous geologically very low permeable layers of thickness not less than 5 m or less than 8 m,

- if the flow rate is larger than 10 m/day.

(5) The determination of the boundaries of the Outer area of the aquifer, which is artificially recharged, depends on the quantity and quality of natural groundwater according to the quantity and quality of surface water used for artificial recharge.

7.3.4 Combined captures

(1) In case that water from the aquifer also flows into the capture of surface water, criteria for determining the boundaries of water protection zones for capture of groundwater are also applied (in addition to the criteria for determining the boundaries of water protection area for captures of surface waters).

(2) In case that the capture simultaneously discharges surface and groundwater, the boundaries of water protection areas should be established using the criteria for groundwater and surface water.

8. PLANNING OF PROTECTIVE MEASURES

Protective measures for the facilities constructions and implementation of the construction works, for which it is expected that during the construction and implementation represent a risk for pollution of the water body, must be planned based on the risk analysis, so that the risk of pollution of the water body due to facilities constructions and implementation of the construction works is acceptable. It is considered that the risk of water body pollution is acceptable if it is clearly evident from the results of the risk analysis of the pollution.

The risk analysis for pollution of water bodies is provided by investor of intervention in the environment in the water protection zone.

8.1 Optimization of protective measures

(1) The risk analysis for pollution must be made using the methods of deterministic or probability risk analysis and using the costs analysis caused due to elimination of pollution effects and loss of water supply.

(2) The cost of protective measures should be evaluated with a comparative economic analysis of the costs and benefits of establishing protective measures, taking into account the costs of drinking water treatment, which due to the introduction of protective measures are not necessary.

8.1.1 Deterministic risk analysis

(1) The acceptability of the pollution risk due to the construction of buildings (Annex 1) or of the construction works (Annex 1) is assessed with deterministic risk analysis on the basis of the following criteria:

- the construction of facilities or implementation of the construction works is acceptable, if the change of any parameter that is subject of risk analysis of pollution does not exceed the relative sensitivity of this parameter (Annex 2),
- the construction of the facility or implementation of the construction works is acceptable if a change of any parameter that is subject to risk analysis for pollution, the value of this parameter does not exceed the limit values for this parameter determined by the regulations governing drinking water.

(2) For parameters where the value of relative sensitivity (Annex 2) is not determined, it is considered that the value of the relative sensitivity is +2.

(3) The substances, which were not presented in the water body before the human intervention in the environment, after an intervention should not appear.

(4) The relative sensitivity is the ratio between the observed value of the new state of water due to threat and the reference state and is calculated as follows:

$$S = (R + \Delta R) / R$$

Where *S* is relative sensitivity and *R* is reference condition, which is equal to the average value of the parameter before the intervention in the environment calculated as the arithmetic mean of the analytical results of the monitoring in drinking water capture in the last five years. If the results of analyses are not available for last five years, the state zero state is determined with additional monitoring of potential pollutants in capture, which must include at least two years of measurements with a minimum frequency of sampling six times a year. *ΔR* presents the change in the reference condition because of threats.

8.1.2 Probability risk analysis

(1) The acceptability of the risk of pollution after probability risk analysis is determined on the basis of the probability of the event, which leads to pollution of the water body.

(2) The probability analysis is performed using the criteria and in a way specified by deterministic risk analysis.

(3) Probabilistic risk analysis is carried out if:

- the probability of an event exceed 10^{-2} per year and the capture supply less than 1,000 inhabitants,
- the probability of an event exceed 10^{-3} per year and the capture supply more than 1,000 inhabitants,
- the probability of an event exceed 10^{-4} per year and the capture supply more than 10,000 inhabitants, or
- the probability of an event exceed 10^{-5} per year and the capture supply more than 100,000 residents.

(4) The risk of pollution of the water body is due to the facility construction within the protection zone based on probability risk analysis acceptable if the relative sensitivity is less than permissible value from Annex 2.

(5) Probability risk analysis should take into account also the risk of pollution from already implemented environmental interventions within the water protection zone.

8.2 The extent and content of risk analysis

(1) Risk analysis of pollution due to the construction of the object in the water protection area includes:

- A description of the risk and the definition of impact scenarios on water source:

  - determination of the number and types of pollutants,
  - definition of the mechanism of the spill and/or release of pollutants,
  - the definition of a scenario of normal and an alternative developments of events and scenario of worst options,

- Identification of pollutants with the assessment:

  - interaction of pollutants and the environment,

- the toxicity of pollutants,
- the mobility of contaminants,
- chemical properties and the amount of pollutants,

- Characteristics of the catchment:

- the description of the capture method,
- estimate the amount of captured water,
- the description of the regime and the dynamics of water resources exploitation,

- The definition of a water source:

- assessment of the state, which is a summary review of the natural background and load in the water source,
- evaluation of the natural background,
- load of the water source,
- the description of the natural characteristics of the water source,

- Definition of transport ways of pollutants from the source of threat to the capture,

- Calculation of the transport of pollutants in relation to the different scenarios,

- Definition of risk for pollution.

(2) Calculation of the pollutants transport has to demonstrate:

- the starting point for the selection of calculation methods,
- verifiability and repeatability of the methods of calculation,
- comparability of the calculation method with other methods, and
- reliability of calculation methods.

(3) When calculating the pollutants transport sensitivity analysis should be carried out that demonstrates the reliability of calculation model. Sensitivity analysis is performed for key parameters of the pollutants transport calculations.

8.3 The revision of risk analysis for pollution

Revision of project documentation is an integral part of the risk analysis for pollution, which checks the impeccability and calculation correctness of the risk analysis.

The revision of documentation shell engage by legal or other person who fulfils the conditions prescribed for revisers according to the construction regulations.

The revision of risk analysis for pollution may carry out also the higher education or other institution that conducts research or educational activities relating to the water resources protection if it has been entered in the register of the activities related to the technical consulting and employees meet the prescribed conditions for responsible reviser according to regulations governing construction.

9 References

Brenčič, M., Prestor, J., Kompare, B., Matoz, H., Kranjc, S., 2009: Integrated approach to delineation of drinking watre protection zones. Geologija, 52/2, 175-182.

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Prestor, J., Matoz, H., Sušin, J., 2008: Implementation of new Rules on criteria for the designation of a water protection zone in Slovenia. Workshop on the protection of groundwater as a source od drinking water in karst areas – Malinska, Island Krk (Croatia). 14-15th April 2008.

Annex 1

List of protection measures in Protection Zones implemented according to the "Rules on Criteria for the Designation of a Water Protection Zone" in Slovenia

DWELLING HOUSES	WPZ I	WPZ II	WPZ III
Single-residence building	-	pd[1]	+[3]
Residential buildings	-	pd[1]	+[3]
Residential buildings for special purposes	-	pd[1]	+[3]

NON-RESIDENTAL BUILDINGS	WPZ I	WPZ II	WPZ III
Lodging houses and restaurants	-	pd[1]	+
Office houses	-	pd[1]	+
Buildings for commerce	-	pd[1]	+
Fair and trade buildings, exhibition grounds	-	pip	+
Petrol and gas stations	-	pip	pip
Buildings for other service activities	-	pd	+
Stations, terminals, buildings for electronic communications, and related buildings	-	pd[6]	pd[10]
Garage buildings	-	pp	pd[3]
Industrial buildings	-	pp	pp
Tanks, silos	-	-	pp
Warehouses for non-dangerous goods	-	pp	pd[1]
Cultural and entertainment buildings	-	pd[1]	+
Museums and libraries	-	pd[1]	+
Buildings for education, research, and development	-	pd[1]	+
Medical buildings	-	pp	pd
Sports halls	-	pd[1]	+
Buildings for plant harvesting	-	pp	pp
Stockbreeding buildings	-	-	pp
Harvest warehouses	-	pd[1]	+
Other non-dwelling farming buildings	-	pd[1]	+
Buildings for religious services	-	pd[1]	+
Cemetery buildings and accompanying constructions	-	pd[1]	pd
Cultural monuments	+	+	+
Other non-dwelling buildings not listed	-	pd[1]	+

TRANSPORT INFRASTRUCTURE	WPZ I	WPZ II	WPZ III
Highways, expressways, major roads, regional roads	pip[2]	pd[2]	pd
Local roads, public roads, non-categorized roads, forest roads except parking lots	pip	+	+

Parking lots	-	pp[2]	pd[2]
Main and regional railroads	pip[9]	pip[9]	pip
Municipal railroads	-	pip[9]	pip
Airport runways and platforms	-	-	pip[2]
Airport communication services – navigation buildings	-	+	+
Bridges and crossings	pip	pd	pd
Tunnels and cuttings	-	pip	pd
Harbours and navigable channels	-	pd	pd
Dams and levees	pd	pd[2,9]	pd
Conducting channels, irrigation channels, drainage channels	-	pp	+

COMPLEX INDUSTRIAL INFRASTRUCTURE	WPZ I	WPZ II	WPZ III
Mining infrastructure	-	-	pip
Buildings for energy management and production	-	pip	pp
Chemical industry infrastructure	-	-	pp
Facilities that can cause large pollution as defined by environmental legislation	-	pp	pp
Production facilities representing risk of possible large scale accidents with dangerous chemicals as defined by environmental legislation	-	pp	pp
Other complex industrial infrastructures not listed	-	-	pip

OTHER CIVIL ENGINEERING CONSTRUCTIONS	WPZ I	WPZ II	WPZ III
Sport places	-	pp	pd
Other civil engineering constructions for sport, sport recreation, and spare time	-	pp	+
Military buildings	-	-	pip
Flood prevention facilities	pip	pip	pd
Landfills and facilities for recycling of dangerous goods	-	-	-
Non-dangerous and inert goods collection facilities	-	-	pp
Cemeteries	-	-	pp
Other civil engineering constructions not listed	-	pp	pd

INFILTRATION STRUCTURES	WPZ I	WPZ II	WPZ III
Groundwater infiltration from one aquifer to another without detected anthropogenic influences	-	pp	pp
Infiltration structure for treated municipal waste water – infiltration through soil covered with vegetation	-	pip[13]	pp[13]
Infiltration structure for treated technological waste water – with a biologically active treatment layer	-	pip[13]	pp[13]
Infiltration of treated rainfall water from paved surfaces	-	pp[13]	pp[13]

INFILTRATION STRUCTURES	WPZ I	WPZ II	WPZ III
Infiltration of precipitation collected on roofs	pd	+	+

CONSTRUCTION WORKS	WPZ I	WPZ II	WPZ III
Construction sites in accordance with construction regulations with a surface not larger than 1 ha	-	pp	pd
Parking places on construction sites for building engines and facilities (without maintenance)	-	pd	+
Maintenance places for building engines and temporary storage facilities for fuels, lubricant oils, and chemicals used in construction	-	pd	+
Construction site toilets	-[12]	-[12]	-[12]
Temporary storage places for elements made of concrete	-	pd	+
Fuel supply for engines and machines on construction sites (fuel decantation)	-	pp	+
Construction site excavation	pd	pd[5]	+[5]
Use and cleaning on construction site of facilities for concrete production, geotechnical facilities, and milling machines	-	pd	+[2]
Shot concrete use	-	pp	+
Waste construction material use	-	pp	+
Recyclable construction material use	-	pp	+
Construction material use with possible leakage of water pollutants	-	-	-
Cleaning and treatment of building surfaces or construction materials where waste water is present (e.g. building front)	-	+	+
Land surface morphology changes with soil embankment construction or soil removal	-	pp	pd
Sealing barriers for water resource protection	pp	pp	pd
Sealing barriers for other uses	-	-	pp
Construction material injection	-	pd[4]	+
Drilling and hammering wood and concrete piles	pp	pd	pd
Drilling without drilling fluids, except for water resource investigation	-	pp	pd
Drilling with drilling fluids	-	-	pd
Drilling – filling of annulus space	+	+	+
Drilling for geothermal energy exploitation – heat exchangers in closed system	pp	pp	pp
Drilling for geothermal energy exploitation – heat exchangers in open system	-	pd	pd
Drilling with biodegradable drilling fluids	pp	+	+

CONSTRUCTION WORKS	WPZ I	WPZ II	WPZ III
Drilling for other uses	-	pd	pd

CONSTRUCTION OF SIMPLE CIVIL ENGINEERING FACILITIES	WPZ I	WPZ II	WPZ III
Auxiliary buildings for private use			
Woodsheds, projecting roofs, sheds, huts	+	+	+
Garages, hotbeds, pools	pd	+	+
Auxiliary infrastructures			
Auxiliary road buildings except water drainage infrastructure and toll houses Auxiliary railroad buildings except water drainage infrastructure Auxiliary cable car buildings Auxiliary buildings for energy production and manipulation except transformers Auxiliary communal buildings except small standardised waste water treatment systems	pd	+	+
Road drainage, toll houses, railway tracks drainage, power supply transformer stations, small typified waste water treatment systems, municipal waste fraction collection sites, airport auxiliary buildings, border crossing auxiliary buildings	-	pd	+[13]
Auxiliary buildings for agriculture and forestry			
Apiaries, forest trails, forest roads, forest sledges, forestry education tracks, forestry cable cars, granaries, hay racks, farm sheds, cart tracks, barns	+	+	+
Dunghills, cesspools[23] up to 150 m^3, greenhouses, fish ponds	-	pd[14]	+
Temporary buildings intended for tourist season activities, tourists arrangements, and warehousing	-	pd	+
Sport grounds and recreational grounds except golf courses			
Sport grounds and recreational grounds, bicycle tracks, mountain paths, walking tracks, promenades, ski slopes[21], parachute and hang-glider runways	pp	+	+
Piers, rifle ranges	-	pd	+
National defence training buildings, training buildings for civil defence, emergency help, and emergency services	-	pd	+
Monuments	+	+	+

CONSTRUCTION OF SIMPLE CIVIL ENGINEERING FACILITIES	WPZ I	WPZ II	WPZ III
Urban equipment			
Stopping places, public bicycle sheds, public telephone boxes, advertisement pillars, stands, sculptures, art installations, multipurpose stands, prefabricated sanitary units, fountains	+	+	+

FERTILIZATION	WPZ I	WPZ II	WPZ III
Fertilization without plan	-	-	-
Fertilization with animal manure and artificial fertilizer	-	+[18]	+[17]
Production of farming plants based on the programme prepared for drinking water Protection Zones without application of artificial fertilizers, liquid manure, or manure deposited for less than six months	+[18]	+	+
Grass tillage	-	+[18]	+[18]
Temporary deposition of manure on the field (more than 1 m^3 altogether)	-	-	+
Temporary deposition of compost on the field except Class I compost (more than 1 m^3 altogether)	-	-	+
Manure use in garden and forestry plantations	-	+[17]	+
Manure and liquid manure in forest use in parks and sport grounds	-	-	-
Liquid manure use on farms, gardens, and forestry plantations	-	+[18]	+[17]
Treatment plants waste mud use on farms, gardens, and forestry plantations	-	-	-
Treatment plants waste mud use in forests, parks, and sport grounds	-	-	-
Artificial fertilizers use in garden and forestry plantations	-	+[18]	+[17]
Artificial fertilizers use in forests, parks, and sports grounds	-	+[18]	+[17]
Compost use on farms, gardens, and forestry plantations, except 1. class compost	-	-	-
Compost use in forests, parks, and sport grounds, except 1. class compost	-	-	-
Manuring with remains from closed cesspits, lavatories, and sewage systems	-	-	-
Manuring of gardens on construction sites, kitchen gardens on agricultural areas, and other empty lands	-	-	+[17]

PLANT AND WOOD PROTECTION AGENTS USE	WPZ I	WPZ II	WPZ III
Use of phytopharmaceutical agents not intended to be applied in drinking water Protection Zones	-	-	-
Use of phytopharmaceutical agents intended to be applied in drinking water Protection Zones in farms, gardens, and forestry plantations	-	+[22]	+
Use of phytopharmaceutical agents intended to be applied in drinking water Protection Zones in gardens on construction sites, kitchen gardens on agricultural areas, and other empty lands	-	-	+
Use of phytopharmaceutical agents intended to be applied in drinking water Protection Zones in parks, forests, cemeteries, and sports grounds	-	+[22]	+
Use of phytopharmaceutical agents intended to be applied in drinking water Protection Zones for transport infrastructure	-	pd[20]	+[20]
Use of phytopharmaceutical agents intended to be applied in drinking water Protection Zones for the railway tracks	-	pd[16]	+[16]
Wood protection agents intended to be applied in drinking water Protection Zones	-	-	+[11]

FORESTRY	WPZ I	WPZ II	WPZIII
Total cutting down of trees	-	-	+
Afforestation	+	+	+

Explanation of abbreviations, signs, and numbers in superscripts:

* In karstic aquifers and fissured aquifers with the characteristics of karstic aquifers where intervention in the Outer protection zone can influence conditions in the Middle Protection Zone, protection measures that are valid for the Middle Protection Zone must be implemented. The same requirement is valid for the relation between the Inner and Middle Protection Zones.

pd[1] – In the Middle Protection Zone it is prohibited to diminish the volume of the aquifer or intersect the groundwater flow or to diminish the protection layer above the aquifer by construction of any building or other civil engineering structure.

pip[2], pp[2], pd[2], +[2] – Protection measures consist of specially designed sealing layers, an uplifted rim of the working area, and diversion of water away from the protection Zone.

+[3], pd[3] – In the Outer Protection Zone buildings and facilities must be constructed 2 m above maximum groundwater level. An exception is allowed if the construction does not

diminish aquifer transmissivity by more than 10%. If during the construction and later operational period, groundwater drainage, or pumping is needed, water consent based on Water Law requirements must be acquired.

pd[4] – Allowed only in the case when landsliding is stabilized.

+[5], pd[5] – Excavations are allowed if the bottom of the pit is higher than 2 m above maximum groundwater level.

pip[6] – In the Middle Protection Zone, construction of cisterns standing in open air used for water treatment with accompanying pipelines and decantation places is allowed; cisterns with a volume of 450 l in a shelter building are allowed; cisterns for crude oil standing in open air with accompanying pipelines and decantation places are allowed if the volume of each storage place is up to 30 m^3; an expert survey must be conducted every second year.

pd[7] – The internal sewerage network must be connected with the public sewerage system. Before the implementation of the internal sewerage system, water tightness must be tested with standard procedures.

pd[7,8] – The internal sewerage network must be connected with the public sewerage system. Before the implementation of the internal sewerage system, water tightness must be tested with the standardized procedures. Water tightness of the public sewerage system must be tested with the standardized procedures.

pip[9] – Railway must be constructed on the sealing layer; all meteoric water must be diverted away from the Protection Zone.

pd[10] – When coach wagons with cisterns for dangerous goods are present in railway stations, special protection measures must be applied.

+[11] – Wood protection agents are allowed in buildings that are constructed for preventing leakage and infiltration into the groundwater or into the water capture facility.

-[12] – Chemical toilet or drainage into the sewerage system is allowed.

pd[13], pip[13], pp[13] – It is prohibited to infiltrate treated waste water into the groundwater or drinking water capture facility before diversions into the surface water course. The bottom of the infiltration facility must be higher than 1 m above maximum groundwater level; encroachment into the groundwater is not allowed during construction of the infiltration facility.

pd[14] – The bottom of the dunghill or cesspit must be higher than 2 m above maximum groundwater level. All constructions must be watertight.

[15] – The bottom of the mineral resources excavation pit must be higher than 2 m above the estimated maximum groundwater level based on the last 10 years of observations.

pd[16], +[16] – Phytopharmaceutical agent application is allowed in accordance with the legal rules defining cooperation of possessors in removing harmful organisms on railway structures.

+[17] – Phytopharmaceutical agent application is allowed if limit values of nitrogen are in accordance with legal rules defining the introduction of dangerous substances and plant nutrients into soil.

+[18] – Allowed in accordance with legal rules defining the introduction of dangerous substances and plant nutrients into soil if it follows from the qualitative monitoring during the last five years that groundwater has good chemical status in accordance with legal rules defining the chemical status of groundwater and none of the annual average values of nitrogen concentration are larger than 10 mg/l.

+[19] – Allowed if 1. class compost is used in accordance with the legal rules defining the introduction of dangerous substances and plant nutrients into soil.

pd[20], +[20] – Phytopharmaceutical agent application is allowed if done in accordance with the legal rules defining liable cooperation of owners in removing harmful organisms on railway structures.

[21] – In Inner Protection Zones, ski slopes are not allowed. On existing ski slopes, the use of snow stabilizing agent is prohibited.

+[22] – Allowed only on intergranular porosity aquifers and on fissured porosity aquifers with the characteristics of karstic aquifer Protection Zones.

[23] – Reconstruction of existing dunghills and cesspits, and, exceptionally, construction of new ones, is allowed as a sanitation measure for existing farm husbandry. The bottom of the dunghill and cesspit must be at least 2 m higher than the maximum groundwater level. All structures must be watertight.

Annex 2

Permissible values of relative sensitivity

Perameter	Unit	Expressed as	The limit of detection (LOD)	Relative sensitivity A	Relative sensitivity B
pH			0.1	–	–
Conductivity	µS/cm		1	+1.25	–
Oxygen	mg/l	O_2	0.5	-1.5	–
OTHER PARAMETERS					
Colour	m^{-1}		0.1	2	–
Turbidity	mg/l		0.5	+2	–
TOC	µg/l	C	0.2	+2	+1.5
AOX	mg/l	Cl	2	+2	+1.5
Ammonium	mg/l	NH4	0.02	+3	+2
Sodium	mg/l	Na	0.1	+2	+1.5
Potassium	mg/l	K	0.1	+2	+1.5
Calcium	mg/l	Ca	1	+2	+1.5
Magnesium	mg/l	Mg	1	+2	+1.5
Iron	µg/l	Fe	10	+4	+2.5
Hydrogen carbonates	mg/l	HCO_3	1	+2	+1.5
Nitrates	mg/l	NO_3	0.1	+2	+1.5
Sulphates	mg/l	SO_4	0.5	+2	+1.5
Chlorides	mg/l	Cl	0.5	+2	+1.5
Orthophosphates	mg/l	PO_4	0.01	+2	+1.5
Boron	mg/l	B	0.02	+2	+1.5
INDICATIVE PARAMETERS					
Nitrites	mg/l	NO_2	0.01	+3	+2
Fluorides	mg/l	F	0.05	+3	+2
Cyanides	µg/l	CN		+3	+2
Sulphides	mg/l	S		+3	+2
Aluminium	µg/l	Al	10	+4	+2.5
Antimony	µg/l	Sb		+4	+2
Arsenic	µg/l	As	2	+4	+2
Cooper	µg/l	Cu	1	+4	+2
Barium	µg/l	Ba		+4	+2
Beryllium	µg/l	Be		+4	+2
Zinc	µg/l	Zn	5	+4	+2
Cadmium	µg/l	Cd	0.1	+4	+2
Cobalt	µg/l	Co		+4	+2
Tin	µg/l	Sn		+4	+2

Chromium (total)	µg/l	Cr	1	+4	+2
Chromium (6+)	µg/l	Cr^{6+}	5	+4	+2
Manganese	µg/l	Mn	2	+4	+2.5
Molybdenum	µg/l	Mo		+4	+2
Nickel	µg/l	Ni	1	+4	+2
Selenium	µg/l	Se		+4	+2
Silver	µg/l	Ag		+4	+2
Lead	µg/l	Pb	1	+4	+2
Thallium	µg/l	Tl		+4	+2
Titanium	µg/l	Ti		+4	+2
Tellurium	µg/l	Te		+4	+2
Vanadium	µg/l	V		+4	+2
Mercury	µg/l	Hg	0.1	–	+2
Mineral oils	µg/l		5	+2	+1.5
Phenolic substances	µg/l	C_6H_5OH	1	+1.5	+1.5
volatile chlorinated hydrocarbons-LKCH	µg/l			+3	+1.5
Tetrachloromethane	µg/l		0.5	–	+1.5
1,2-Dichloroethan	µg/l		0.5	–	+1.5
1,1-Dichloroethen	µg/l		0.5	–	+1.5
Trichloroethen	µg/l		0.5	–	+1.5
Tetrachloroethen	µg/l		0.5	–	+1.5
Volatile aromatic hydrocarbons-BTX	µg/l			+3	+1.5
Polychlorinated biphenyls-PCB	µg/l		0.005*	+4	+1.5
Polycyclic aromatic hydrocarbons-PAH	µg/l		0.04	+3	+1.5
Phytopharmaceutic substances**					
The sum of active substances and their degradation compounds from the rules on monitoring of surface water chemical status	µg/l			+3	+1.5
Other phytopharmaceutic products covered Rules on the	µg/l		Values from Regulation	–	+2

monitoring of chemical status of surface waters					
The sum of active substances and their degradation compounds from the Rules of the emission monitoring groundwater	µg/l			+3	+1.5
Other phytopharmaceutic products covered Rules on emission monitoring of groundwater	µg/l		Values from Regulation	−	+2

***** Applies to single isomer

****** For deterministic risk analysis as phytopharmaceutic products under this Regulation considered pesticides and their metabolites (degradation compounds) from the regulations that determine the chemical status of surface water and groundwater quality.

A: Relative sensitivity applies to the results of the deterministic risk analysis, which

value is lower than five times of the limit

B: Relative sensitivity applies to the results of the deterministic risk analysis, which

value is greater than five times of the limit

Slovenian Rules on criteria for the designation of a water protection zone - Ljubljana, October 2016

Let's grow up together

DRINK ADRIA

Adriatic IPA
Cross Border Cooperation 2007-2013

The project is co-funded by the European Union,
Instrument for Pre-Accession Assistance

Croatian legislation for determination of drinking water source protection zones

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Table of content

1. Introduction

Basic regulation which defines protection measures for drinking water sources and sanitary protection zones of drinking water sources is **Water Act** (Official Gazette of Republic of Croatia (OG). 153/09, 130/11, 56/13, 14/14, *in Croatian: Zakon o vodama*).

In **Regulation on conditions for determining sanitary protection zones of water sources** (OG 066/2011, 047/2013; in Croatian: *Pravilnik o uvjetima za utvrđivanje zona sanitarne zaštite izvorišta*) detailed conditions for determining sanitary protection zones for water sources that are used for public water supply, measures and limitations which are implemented in them, deadlines and procedures for making decisions on water sources protection are defined.

This Regulation is not applied to:

- water sources for which is granted the concession for economic use of water from Article 163 of Water Act (OG 153/09, 130/11, 56/13, 14/14),

- water sources which are not used, and are not planned to be used as a reserve water source for public water supply, but in accordance with the concession agreement or water management permit serve for economic use.

Most important parts of the Regulation on conditions for determining sanitary protection zones of water sources are given in the following text.

2. Conditions for determining sanitary protection zones

Sanitary protection zones for drinking water sources can be determined:

1. if water-research works are carried out and
2. if study of sanitary protection zones is made.

Water-research works are works and tests referred to Article 91, Paragraph 2 of the Water Act, which include geological, hydrogeological, hydrological, hydrogeochemical and chemical research**,** especially regarding the determination of the following characteristics:

- geological features and hydrogeological relations of catchment area,

- hydrological features of catchment area,

- aquifer size, boundaries and abundance,

- aquifer type with respect to the porosity (intergranular, fracture and fracture-cavernous),

- thickness and permeability of aquifer cover deposits,

- the way of aquifer recharge,

- the way of water inflow into the reservoir or lake,

- groundwater flow velocity,

- purification capacity of cover deposits and aquifer,

– water quality and

- analysis of natural system and total impact of human activity.

A draft of the study of sanitary protection zones is made based on existing water-research works. The report of Study of sanitary protection zones contains following:

1. Introduction,
2. Technical description of the water-intake,
3. Geological and hydrological characteristics of catchment area of the affected ground water source ,
4. Hydrological characteristics for water sources with surface water intake,
5. Established aquifer boundaries,
6. Proposal of the boundaries of sanitary protection zones (graphic and descriptive presentation),
7. Description of water quality status,
8. Cadastre of pollutants with graphical representation of the locations,
9. Proposal of measures for water sources protection (passive and active), including restrictions and prohibitions related to human activities which may adversely affect the condition of water abstracted from water sources,
10. Principal proposal for recovery procedures on the existing facilities within the sanitary protection zones of water sources,
11. Suggestion of places for setting the signs of corresponding sanitary protection zones.

Study of sanitary protection zones must be also made in digital form.

Basic graphical presentations with all the necessary data for the IV and III sanitary protection zone are in scale of 1:25.000, for the II sanitary protection zone in scale of 1:5.000, and for the I sanitary protection zone in scale of 1:1.000.

3. The procedure of making decisions for water sources protection

After fulfilling the conditions set in Article 2 of this Regulation, that is water-research works carried out and study of sanitary protection zones done, the prefect (county ruler), mayor and municipal mayor in the cases referred in Article 91, Paragraph 2 of the Water Act will establish the commission for preparation of a draft of decision on water sources protection.

Further process of making decision on water source protection is carried out according to the regulations on the adoption of general acts of local government units and regional government units.

The authority referred in Article 91, Paragraph 2 of the Water Act, within 12 months from the date of the decision on water sources protection brings the Program of recovery measures within the sanitary protection zones for existing buildings and existing activities which becomes an integral part of the decision on water sources protection.

The Program of recovery measures contains in particular:

- a list of all pollutants in sanitary protection zones,
- priority recovery procedures,
- deadlines for the implementation of recovery works,
- the costs of recovery,
- payers for funding of the implementation of Program of recovery measures.

4. Classification of water sources and delineation of protection zones

Within this Regulation for the purpose of determining the extent of water-research works and delineation of sources protection zones, sources are classified as:

1. sources with a maximum capacity up to 20 l/s in terms of the pumping dynamics,
2. sources with a maximum capacity from 20 l/s to 100 l/s in terms of the pumping dynamics and

3. sources with a maximum capacity greater than 100 l/s in terms of the pumping dynamics.

Sanitary protection zones are determined according to the aquifer type for:

1. sources with abstraction from groundwater, as follows:

   - from aquifer with intergranular porosity and

   - from aquifer with fracture and fracture-cavernous porosity;

2. sources with abstraction of surface water, as follows:

   - from reservoirs and lakes and

   - from open watercourses.

5. Sanitary protection zones for sources with abstraction from groundwater

5.1. Sanitary protection zones for sources with abstraction of water from an aquifer with intergranular porosity

Sanitary protection zones for sources with abstraction of water from an aquifer with intergranular porosity are:

- zone of restriction and surveillance - III zone,

- zone of strict restriction and surveillance - II zone and

- zone of strict protection regime and surveillance – I zone.

III sanitary protection zone of sources with abstraction of water from an aquifer with intergranular porosity is particularly determined to reduce the risk of groundwater pollution by hardly degradable hazardous substances and pollutants.

III sanitary protection zone of sources with abstraction of water from an aquifer with intergranular porosity includes:

– for sources with a maximum capacity up to 20 l/s in terms of the pumping dynamics, the area outside the II zone boundary up to the calculated boundary of recharge area for the minimum retention time of water in the underground for a period of 5 years of horizontal flow, before entering the water intake structure,

– for sources with a maximum capacity from 20 l/s to 100 l/s in terms of the pumping dynamics, the area outside the II zone boundary up to the calculated boundary of recharge area for the minimum retention time of water in the underground for a period of 15 years of horizontal flow, before entering the water intake structure and

– for sources with a maximum capacity greater than 100 l/s in terms of the pumping dynamics, the area outside the II zone boundary up to the calculated boundary of recharge area for the minimum retention time of water in the underground for a period of 25 years of horizontal flow, before entering the water intake structure.

In the III sanitary protection zone of sources with abstraction of water from an aquifer with intergranular porosity is forbidden:

- discharge of untreated wastewater;

- waste storage and disposal, construction of landfill-except for the remediation of the existing one for the purpose of its closure, construction of buildings for waste management including waste incinerators and facilities for treatment, recovery and management of hazardous waste;

- construction of chemical industrial plants of hazardous substances and pollutants for water and water environment;

- construction of petrol (gas) stations without tanks with double wall, device for automatic detection and leakage alarm and protective building;

- underground and surface exploitation of mineral resources except geothermal and mineral waters,

- construction of roads, airports, parking lots and other traffic and handling areas without controlled drainage and adequate treatment of polluted storm water before their discharge into natural receiver.

Exceptionally is allowed the construction of center for waste management, in accordance with special regulations on waste, under certain conditions!

II sanitary protection zone of sources with abstraction of water from an aquifer with intergranular porosity is determined to reduce the risk of groundwater contamination by pathogenic microorganisms and of other harmful effects that may occur during the water retention in the underground.

II sanitary protection zone of sources with abstraction of water from an aquifer with intergranular porosity includes the area outside the boundary of I zone up to the line from which groundwater has minimum retention time in the underground of 50 days before entering the water intake structure.

If the vertical water flow is greater than 50 days of duration before entering the water intake structure, II sanitary protection zone is not determined.

In the II sanitary protection zone of sources with abstraction of water from an aquifer with intergranular porosity are applied prohibitions from III zone, and also is forbidden:

- agricultural production, except organic production with the use of permitted fertilizers and plant protection products according to a special regulation;

- livestock breeding, except farms up to 20 livestock units with implementation of water protection measures prescribed with appropriate program for the protection of waters against pollution caused by nitrates of agricultural origin and principles of good agricultural practices;

- discharge of treated and untreated waste water from roads;

- establishment of new and expansion of existing cemeteries;

- waste storage and disposal, construction of landfill except for the remediation of existing one for the purpose of its closure, buildings for waste management including waste incinerators, regional and county waste management centers, recycling yards and waste reloading stations if there is not planned the implementation of water protection measures and facilities for treatment, recovery and disposal of hazardous waste;

- performance of exploration and exploitation boreholes, except those related to water research works for public water supply and renewable energy sources.

I sanitary protection zone of sources with abstraction of water from an aquifer with intergranular porosity is determined to protect water sources, water intake structures and their immediate surroundings from any damage, water pollution and other accidental or deliberate harmful effects.

The boundary of I sanitary protection zone of sources with abstraction of water from an aquifer with intergranular porosity must be away from the water intake structures at least 10 meters in all directions and must be enclosed by stable fence high enough to prevent the entry of unauthorized persons.

In the I sanitary protection zone of sources with abstraction of water from an aquifer with intergranular porosity are prohibited all activities except for those related to abstraction, conditioning and transport of water into the water supply system.

5.2. Sanitary protection zones for sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity

Sanitary protection zones for sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity are determined to reduce the risk of contamination of the aquifer with fracture and fracture-cavernous porosity.

Sanitary protection zones for sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity are:

- zone of restriction - IV zone,
- zone of restriction and surveillance - III zone,
- zone of strict restriction and surveillance - II zone and
- zone of strict protection regime and surveillance – I zone.

If in the highland areas outside of zones boundaries, there are areas of collection, retention and runoff of water toward the water source, those areas can be determined as special water supply reserves. With Decision on sources protection on special water supply reserves can be optionally applied measures of passive water sources protection that apply to IV, III and II sanitary protection zone of sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity.

IV sanitary protection zone of sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity includes water source catchment area outside the III zone with possible flow through fracture and fracture-cavernous underground in high water conditions, to the water intake in a period of:

– 10 to 20 days for sources with a maximum capacity up to 20 l/s in terms of the pumping dynamics,

– 20 to 40 days for sources with a maximum capacity from 20 l/s to 100 l/s in terms of the pumping dynamics and

– 40 to 50 days for sources with a maximum capacity greater than 100 l/s in terms of the pumping dynamics

Exceptionally, IV sanitary protection zone of sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity can be determined so that it includes water source catchment outside the III zone, on which apparent velocities of underground flow less then 1 cm/s are determined, as well as the total inflow area that participates in recovery of associated source's waters.

In IV sanitary protection zone for sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity is forbidden:

- discharge of untreated wastewater,

- construction of plants for production of hazardous and polluting substances for waters and water environment,

- construction of buildings for recovery, treatment and disposal of hazardous waste;

- storage of radioactive and hazardous substances and pollutants for water and water environment, except for the storage of fuel oil quantities sufficient for domestic needs, motor fuel and lubricants for agricultural machinery, if the prescribed safety measures for building, transportation, loading, storage and use are carried out,

- building of petrol (gas) stations without protective structures for petroleum products tanks

- performance of exploration and exploitation boreholes for oil, natural gas as well as making of underground storages,

- removing the cover layer of soil, except on the construction sites of buildings which are allowed to be built under the provisions of this Regulation,

- buildings of roads, parking lots and airports without drainage structures, devices for oils and fats collection and adequate system for treatment of polluted storm water and

- use of powder (in bulk) explosives for larger scale mining.

III sanitary protection zone for sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity includes parts of basin from the external border of II zone to the border from which flow through the underground to the water intake is possible in the period from 1 to 10 days in high water conditions, or areas on which are determined apparent velocities of groundwater flow from 1 to 3 cm/s, or area that includes most of the catchment area (classical statistical hydro-geological basin).

In III sanitary protection zone of sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity are applied prohibitions from IV zone, and also is forbidden:

- waste storage and disposal, construction of landfill-except for the remediation of the existing one for the purpose of its closure, construction of buildings for waste management including waste incinerators and facilities for treatment, recovery and disposal of hazardous waste;

- construction of pipelines for transport of liquids that can cause water pollution without prescribed water protection,

- construction of petrol (gas) stations without tanks with double wall, device for automatic detection and leakage alarm and protective building;

- underground and surface exploitation of mineral resources except geothermal and mineral waters.

Exceptionally in III sanitary protection zone of sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity is allowed to build a waste management center, in accordance with special regulations on waste, under the terms of this Regulation.

In agricultural production, including livestock breeding, agricultural economies (farms) are obliged to provide conditions and implement measures referred in this Regulation.

II sanitary protection zone for sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity includes main underground drainage routes in the immediate watershed of the source, with possible flow through fissure aquifer system to the water intake for up to 24 hours, or areas from which are determined apparent velocities of groundwater flow, in high water conditions, greater than 3.0 cm/s, or the inner part of the classic inflow area.

Swallow-holes and swallow-hole zones are enclosed with stable fence and are labeled as II zone.

In II sanitary protection zone of sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity are applied prohibitions from III zone, and also is forbidden:

- agricultural production, except organic production with the use of permitted fertilizers and plant protection products according to a special regulation,

- livestock breeding, except farms up to 20 livestock units with implementation of water protection measures prescribed with appropriate program for the protection of waters against pollution caused by nitrates of agricultural origin and principles of good agricultural practices,

- construction and expansion of existing cemeteries,

- discharge of treated and untreated waste water from roads,

- construction of all industrial plants that pollute water and water environment,

- construction of other buildings which may endanger groundwater quality,

- deforestation except sanitary cutting,

- waste storage and disposal, construction of landfill except for the sanation of existing one for the purpose of its closure, buildings for waste management including waste incinerators, regional and county waste management centers, recycling yards and waste reloading stations if there is not planned the implementation of water protection measures and facilities for treatment, recovery and disposal of hazardous waste.

I sanitary protection zone of sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity is determined to protect buildings and devices for water abstraction.

I sanitary protection zone of sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity includes immediate floodplain area of water intake, the source of aquifer with fracture and fracture-cavernous porosity, water capture, pumping stations, water conditioning plants, structures for protection of locations for artificial recharge of aquifers with fracture porosity, regardless of the distance from the water intake.

For large flood areas on steep and inaccessible terrain, I zone can be divided into I.A and I.B zone.

Zones I and I.A must have fence.

In I sanitary protection zone of water sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity all activities are prohibited except for those related to abstraction, conditioning and transport of water into the water supply system.

6. Sanitary protection zones for sources with abstraction from surface waters

6.1. Sanitary protection zones for sources with abstraction of water from reservoirs and lakes

Sanitary protection zones for reservoirs and lakes are:

- zone of restriction and surveillance - III zone,

- zone of strict restriction and surveillance - II zone and

- zone of strict protection regime and surveillance – I zone

III sanitary protection zone for reservoirs and lakes is determined to protect the reservoir or lake from the impact from surfaces in the watershed of reservoir or lake.

III sanitary protection zone of reservoirs and lakes is determined only for reservoirs and lakes to which water flows only from land surface, and not from watercourses or torrents.

III sanitary protection zone for reservoirs and lakes includes the zone from the border of II zone to the outer border of reservoir or lake watershed.

In III sanitary protection zone for reservoirs and lakes is forbidden:

- waste storage and disposal, construction of landfill except for the remediation of existing one for the purpose of its closure, buildings for waste management including waste incinerators, regional and county waste management centers, recycling yards and waste reloading stations if there is not planned the implementation of water protection measures and facilities for treatment, recovery and disposal of hazardous waste,

- discharge of untreated wastewater,

- storage of petroleum and petroleum products,

- construction of facilities for storage, transport, handling, treatment and disposal of radioactive and other substances hazardous for water,

- construction of roads without drainage structures and devices for collecting oil and fats and treatment of polluted rainwater,

- exploitation of gravel, sand, stone and clay,

- construction of industrial plants without systems for wastewater collection and treatment,

- construction of pipelines for fluids that can cause water pollution.

In agricultural production, including livestock production, agricultural economies (farms) are obliged to provide conditions and implement measures referred in Article 1, paragraph 3 of this Regulation.

II sanitary protection zone for reservoirs and lakes is determined to protect the reservoir or lake from pollution brought by permanent or temporary water inflows.

II sanitary protection zone for reservoirs and lakes includes zone which is wide at least 100 m on each side of the inflow, measured from the outer border of I zone, and extends along the inflow to the border of reservoir or lake sub-basin, and the area of 100 m along the reservoir or lake measured from the outer border of I zone.

In II sanitary protection zone for reservoirs and lakes are applied prohibitions from III zone, and also is forbidden:

- agricultural production, except organic production with the use of permitted fertilizers and plant protection products according to a special regulation,

- livestock breeding, except farms up to 20 livestock units with implementation of water protection measures prescribed with appropriate program for the protection of waters against pollution caused by nitrates of agricultural origin and principles of good agricultural practices,

- construction of cemeteries and their extension,

- construction of other buildings that may endanger the quality of water in reservoirs and lakes.

I sanitary protection zone for reservoirs and lakes is determined to protect reservoirs and lakes and water-intakes from any damage, pollution and contamination, and other accidental or deliberate adverse effects.I sanitary protection zone for reservoirs and lakes includes the reservoir ie. lake, dam, water intake structure, pumping station, water conditioning plant, building for protection of the source, protective settling tanks at the confluence of the inflow and protective zone along the reservoir or lake 10 m wide from the water's edge at the highest water level.

In the I sanitary protection zone for reservoirs and lakes have to be fenced: water intake structure, pumping stations, water conditioning plants and buildings for protection of the source.

In the I sanitary protection zone for reservoirs and lakes are applied prohibitions from II zone, and also is forbidden:

- performance of works, construction and performing economic and other activities except for those which are necessary for abstraction, treatment and transport of water into the water supply system,

- use of fertilizers and plant protection products,

- discharge of waste water from operating buildings and water for washing the drinking water conditioning plant,

- use of all boat types, water sports and swimming,

- fishing, sport fishing and fish farming,

- keeping and watering livestock

- public transport of vehicles and pedestrians.

6.2. Sanitary protection zones for sources with abstraction of water from open watercourses

For abstraction of water from open watercourse only I sanitary protection zone is determined.

I sanitary protection zone for open watercourse includes the area of direct water intake, river bed and river bank along the intake, pumping stations, drinking water treatment plant, structures for protection of water source, and the opposite bank in width of 10 m from the edge of river bed if the river bed is **narrower** than 20 m at low waters.

Boundary of I sanitary protection zone of open watercourse in the watercourse must be at least 10 m away from the water intake structure in all directions, and it is marked by buoys.

In the I sanitary protection zone of open watercourse the boundary, in relation to the structures at the bank above the level of high water, must be at least 10 m away in all directions from the following structures: water intake, pumping station, water conditioning plant, structures for protection of water source and it must be enclosed with a stable fence.

In the I sanitary protection zone for open watercourse is forbidden:

- performance of works, construction and performing economic and other activities except for those which are necessary for abstraction, treatment and transport of water into the water supply system,

- discharge of waste water from operating buildings and water for washing the drinking water conditioning plant,

- use of fertilizers and plant protection products,

- use of all boat types, anchoring, water sports and swimming,

- fishing and sport fishing,

- keeping and watering livestock,

- public transport of vehicles and pedestrians,

- deepening of the river bed and

- exploitation of gravel, sand, stone and clay.

7. Protection measures in the zones

In sanitary protection zones passive and active protection measures are conducted.

Passive protection measures are prohibitions given in this Regulation for different aquifer type and protection zone.

Active protection measures are water quality monitoring on the catchment area of the water source and undertaking activities to improve water status, in particular: construction of water structures for public water supply and wastewater disposal, the introduction of clean production, organization of organic agricultural production, installation of containers for hazardous and polluting substances with additional multiple protection and other measures which improve water status.

Exceptionally interventions in the area can be allowed or certain activities in sanitary protection zones of underground aquifers:

1. if detailed water-research works are conducted which examine the impact of narrow area of sanitary protection zone where it is planned to perform an intervention in area or perform certain activity (micro zone) on the aquifer,

2. if based on detailed water-research works a special study is made which has the purpose to prove the circumstances from paragraph 2 or 3 of Article 36 (in text: micro-zoning study),

3. if with micro-zoning study appropriate measures for aquifer protection in micro-zone are predicted.

With legal water conditions the implementation of actions referred in Article 36 of this Regulation will be determined to the investor of planned intervention in micro-zone.

The actions referred in Article 36 of this Regulation for the purpose of approval of activities that are otherwise forbidden in sanitary protection zone are implemented by interested person or local government unit or regional government unit to whom the decision on water sources protection relates.

Croatian waters will publish guidelines for determining sanitary protection zones as technical assistance to local government units and regional government units and to authorized persons referred in Article 43 of this Regulation in application of the provisions of this Regulation and making decisions on water source protection.

If in sanitary protection zone are situated buildings which are constructed in accordance with the regulations on spatial planning and construction, and whose construction is forbidden by this Regulation, or if in sanitary protection zone are situated buildings which are constructed contrary to regulations on spatial planning and construction, and whose construction is forbidden by this Regulation, or if in sanitary protection zone is performed the activity whose performance is forbidden by this

Regulation, local government unit or regional government unit to which the decision on water sources protection relates will determine with a special Act the continuous monitoring of the impact of those buildings or activities on the water source.

Table: Drinking water sources protection from Croatian legislation

AQUIFER TYPE		ZONE	DELINEATION	PASSIVE MEASURES (prohibitions)
GROUNDWATER	INTERGRANULAR POROSITY	III zone - zone of restriction and surveillance	– for sources with a maximum capacity up to 20 l/s in terms of the pumping dynamics, the area outside the II.zone boundary up to the calculated boundary of recharge area for the minimum retention time of water in the underground for a period of 5 years of horizontal flow, before entering the water intake structure, – for sources with a maximum capacity from 20 l/s to 100 l/s in terms of the pumping dynamics, the area outside the II.zone boundary up to the calculated boundary of recharge area for the minimum retention time of water in the underground for a period of 15 years of horizontal flow, before entering the water intake structure and – for sources with a maximum capacity greater than 100 l/s in terms of the pumping dynamics, the area outside the II.zone boundary up to the calculated boundary of recharge area for the minimum retention time of water in the underground for a period of 25 years of horizontal flow, before entering the water intake structure.	It is prohibited: - discharge of untreated wastewater; - waste storage and disposal, construction of landfill-except for the remediation of the existing one for the purpose of its closure, construction of buildings for waste management including waste incinerators and facilities for treatment, recovery and management of hazardous waste; - construction of chemical industrial plants of hazardous substances and pollutants for water and water environment; - construction of petrol (gas) stations without tanks with double wall, device for automatic detection and leakage alarm and protective building; - underground and surface exploitation of mineral resources except geothermal and mineral waters, - construction of roads, airports, parking lots and other traffic and handling areas without controlled drainage and adequate treatment of polluted storm water before their discharge into natural receiver. Exceptionally is allowed the construction of center for waste management, in accordance with special regulations on waste, under certain conditions!

Croatian legislation for determination of drinking water protection zones

		II zone- zone of strict restriction and surveillance	II sanitary protection zone of sources with abstraction of water from an aquifer with intergranular porosity includes the area outside the boundary of I. zone up to the line from which groundwater has minimum retention time in the underground of 50 days before entering the water intake structure. If the vertical water flow is greater than 50 days of duration before entering the water intake structure, II sanitary protection zone is not determined.	All prohibitions from III. zone and: - agricultural production, except organic production with the use of permitted fertilizers and plant protection products according to a special regulation; - livestock breeding, except farms up to 20 livestock units with implementation of water protection measures prescribed with appropriate program for the protection of waters against pollution caused by nitrates of agricultural origin and principles of good agricultural practices; - discharge of treated and untreated waste water from roads; - establishment of new and expansion of existing cemeteries; - waste storage and disposal, construction of landfill except for the remediation of existing one for the purpose of its closure, buildings for waste management including waste incinerators, regional and county waste management centers, recycling yards and waste reloading stations if there is not planned the implementation of water protection measures and facilities for treatment, recovery and disposal of hazardous waste; - performance of exploration and exploitation boreholes, except those related to water research works for public water supply and renewable energy sources.
		I zone - zone of strict protection regime and surveillance	The boundary of I sanitary protection zone of sources with abstraction of water from an aquifer with intergranular porosity must be away from the water intake structures at least 10 meters in all directions.	Prohibited all activities except for those related to abstraction, conditioning and transport of water into the water supply system. It must be enclosed by stable fence high enough to prevent the entry of unauthorized persons.

Croatian legislation for determination of drinking water protection zones

GROUNDWATER	**FRACTURE AND FRACTURE-CAVERNOUS POROSITY**	**IV zone - zone of restriction**	IV sanitary protection zone of sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity includes water source catchment area outside the III. zone with possible flow through fracture and fracture-cavernous underground in high water conditions, to the water intake in a period of: – 10 to 20 days for sources with a maximum capacity up to 20 l/s in terms of the pumping dynamics, – 20 to 40 days for sources with a maximum capacity from 20 l/s to 100 l/s in terms of the pumping dynamics and – 40 to 50 days for sources with a maximum capacity greater than 100 l/s in terms of the pumping dynamics. Exceptionally, IV sanitary protection zone of sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity can be determined so that it includes water source catchment outside the III. zone, on which apparent velocities of underground flow less than 1 cm/s are determined, as well as the total inflow area that participates in recovery of associated source's waters.	It is forbidden: - discharge of untreated wastewater, - construction of plants for production of hazardous and polluting substances for waters and water environment, - construction of buildings for recovery, treatment and disposal of hazardous waste; - storage of radioactive and hazardous substances and pollutants for water and water environment, except for the storage of fuel oil quantities sufficient for domestic needs, motor fuel and lubricants for agricultural machinery, if the prescribed safety measures for building, transportation, loading, storage and use are carried out, - building of petrol (gas) stations without protective structures for petroleum products tanks - performance of exploration and exploitation boreholes for oil, natural gas as well as making of underground storages, - removing the cover layer of soil, except on the construction sites of buildings which are allowed to be built under the provisions of this Regulation, - buildings of roads, parking lots and airports without drainage structures, devices for oils and fats collection and adequate system for treatment of polluted storm water and - use of powder (in bulk) explosives for larger scale mining.

Croatian legislation for determination of drinking water protection zones

		III zone - zone of restriction and surveillance	III. sanitary protection zone for sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity includes parts of basin from the external border of II. zone to the border from which flow through the underground to the water intake is possible in the period from 1 to 10 days in high water conditions, or areas on which are determined apparent velocities of groundwater flow from 1 to 3 cm/s, or area that includes most of the catchment area (classical statistical hydrogeological basin).	All prohibitions from IV zone and: - waste storage and disposal, construction of landfill-except for the remediation of the existing one for the purpose of its closure, construction of buildings for waste management including waste incinerators and facilities for treatment, recovery and disposal of hazardous waste; - construction of pipelines for transport of liquids that can cause water pollution without prescribed water protection, - construction of petrol (gas) stations without tanks with double wall, device for automatic detection and leakage alarm and protective building; - underground and surface exploitation of mineral resources except geothermal and mineral waters. Exceptionally is allowed to build a waste management center, in accordance with special regulations on waste, under the terms of this Regulation. In agricultural production, including livestock production, agricultural economies (farms) are obliged to provide conditions and implement measures referred in this Regulation.
		II zone - zone of strict restriction and surveillance	II sanitary protection zone for sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity includes main underground drainage routes in the immediate watershed of the source, with possible flow through fissure aquifer system to the water intake for up to 24 hours, or areas from which are determined apparent velocities of groundwater flow, in high water conditions, greater than 3.0 cm/s, or the inner part of the classic inflow area. Ponors and ponor zones are enclosed with stable fence and are labeled as II zone.	All prohibitions from III zone and: - agricultural production, except organic production with the use of permitted fertilizers and plant protection products according to a special regulation, - livestock production, except farms up to 20 livestock units with implementation of water protection measures prescribed with appropriate program for the protection of waters against pollution caused by nitrates of agricultural origin and principles of good agricultural practices, - construction and expansion of existing cemeteries, - discharge of treated and untreated waste water from roads, - construction of all industrial plants that pollute water and water environment, - construction of other buildings which may endanger groundwater quality, - deforestation except sanitary cutting, - waste storage and disposal, construction of landfill except for the remediation of existing one for the purpose of its closure, buildings for waste management including waste incinerators, regional and county waste management centers, recycling yards and waste reloading stations if there is not planned the implementation of water protection measures and facilities for treatment, recovery and disposal of hazardous waste.

Croatian legislation for determination of drinking water protection zones

		I zone - zone of strict protection regime and surveillance	I sanitary protection zone of sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity includes immediate floodplain area of water intake, the source of aquifer with fracture and fracture-cavernous porosity, water capture, pumping stations, water conditioning plants, structures for protection of locations for artificial recharge of aquifers with fracture porosity, regardless of the distance from the water intake. For large flood areas on steep and inaccessible terrain, I zone can be divided into I.A and I.B zone.	In I sanitary protection zone of water sources with abstraction of water from an aquifer with fracture and fracture-cavernous porosity all activities are prohibited except for those related to abstraction, conditioning and transport of water into the water supply system. Zones I and I.A must have fence.
SURFACE WATER	**RESERVOIRS AND LAKES**	**III zone - zone of restriction and surveillance**	III sanitary protection zone for reservoirs and lakes includes the zone from the border of II zone to the outer border of reservoir or lake watershed.	It is prohibited: - waste storage and disposal, construction of landfill except for the remediation of existing one for the purpose of its closure, buildings for waste management including waste incinerators, regional and county waste management centers, recycling yards and waste reloading stations if there is not planned the implementation of water protection measures and facilities for treatment, recovery and disposal of hazardous waste, - discharge of untreated wastewater, - storage of petroleum and petroleum products, - construction of facilities for storage, transport, handling, treatment and disposal of radioactive and other substances hazardous for water, - construction of roads without drainage structures and devices for collecting oil and fats and treatment of polluted rainwater, - exploitation of gravel, sand, stone and clay, - construction of industrial plants without systems for wastewater collection and treatment, - construction of pipelines for fluids that can cause water pollution.

Croatian legislation for determination of drinking water protection zones

		II zone - zone of strict restriction and surveillance	II sanitary protection zone for reservoirs and lakes is determined to protect the reservoir or lake from pollution brought by permanent or temporary water inflows**.** II sanitary protection zone for reservoirs and lakes includes zone which is wide at least 100 meters on each side of the inflow, measured from the outer border of I. zone, and extends along the inflow to the border of reservoir or lake sub-basin, and the area of 100 m along the reservoir or lake measured from the outer border of I. zone.	All prohibitions from III zone and: - agricultural production, except organic production with the use of permitted fertilizers and plant protection products according to a special regulation, - livestock breeding, except farms up to 20 livestock units with implementation of water protection measures prescribed with appropriate program for the protection of waters against pollution caused by nitrates of agricultural origin and principles of good agricultural practices, - construction of cemeteries and their extension, - construction of other buildings that may endanger the quality of water in reservoirs and lakes.
		I zone - zone of strict protection regime and surveillance	I sanitary protection zone for reservoirs and lakes includes the reservoir ie. lake, dam, water intake structure, pumping station, water conditioning plant, building for protection of the source, protective settling tanks at the confluence of the inflow and protective zone along the reservoir or lake 10 m wide from the water's edge at the highest water level.	All prohibitions from II zone and: - performance of works, construction and performing economic and other activities except for those which are necessary for abstraction, treatment and transport of water into the water supply system, - use of fertilizers and plant protection products, - discharge of waste water from operating buildings and water for washing the drinking water conditioning plant, - use of all boat types, water sports and swimming, - fishing, sport fishing and fish farming, - keeping and watering livestock and - public transport of vehicles and pedestrians. In the I sanitary protection zone for reservoirs and lakes have to be fenced: water intake structure, pumping stations, water conditioning plants and buildings for protection of the source.

Croatian legislation for determination of drinking water protection zones

SURFACE WATER	**OPEN WATERCOURSES**	**I zone**	I sanitary protection zone for open watercourse includes the area of direct water intake, river bed and river bank along the intake, pumping stations, drinking water treatment plant, structures for protection of water source, and the opposite bank in width of 10 m from the edge of river bed if the river bed is narrower than 20 m at low waters. Boundary of I sanitary protection zone of open watercourse in the watercourse must be at least 10 m away from the water intake structure in all directions, and it is marked by buoys. In the I sanitary protection zone of open watercourse the boundary, in relation to the structures at the bank above the level of high water, must be at least 10 m away in all directions from the following structures: water intake, pumping station, water conditioning plant, structures for protection of water source.	It is prohibited: - performance of works, construction and performing economic and other activities except for those which are necessary for abstraction, treatment and transport of water into the water supply system, - discharge of waste water from operating buildings and water for washing the drinking water conditioning plant, - use of fertilizers and plant protection products, - use of all boat types, anchoring, water sports and swimming, - fishing and sport fishing, - keeping and watering livestock, - public transport of vehicles and pedestrians, - deepening of the river bed and - exploitation of gravel, sand, stone and clay. It must be enclosed with a stable fence.

Croatian legislation for determination of drinking water protection zones

8. References

[1] Zakon o vodama (Water Act), 2014. Official Gazette of Republic of Croatia No. 153/09, 130/11, 56/13, 14/14**.**

[2] Pravilnik o uvjetima za utvrđivanje zona sanitarne zaštite izvorišta (Regulation on conditions for determining sanitary protection zones of water sources), 2013. Official Gazette No. 066/2011, 047/2013. Online available: http://narodne-novine.nn.hr/clanci/sluzbeni/2011_06_66_1460.html (15.1.2015.)

Croatian legislation for determination of drinking water protection zones

Rijeka, May 2015

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Adriatic IPA
Cross Border Cooperation 2007-2013

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Summary report for Drinking Water Supply Protection zones Delineation

Jaroslav Černi Institute for
Water resources Development
Belgrade, Serbia
(FB10)

Belgrade, 2015

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1 Introduction

In Republic of Serbia drinking water supply sources protection zones legal framework includes:

1. *Water Act* (Official gazette of Republic of Serbia 30/2010 and 93/2012), original title*: Zakon o vodama*;

2. *Drinking water supply sources management and protection Act* (Official gazette of Republic of Serbia, no. 27/77, 24/85, 29/88, 49/89 and 46/91) original title: *Zakon o iskorišćavanju i zaštiti izvorišta vodosnabdevanja*;

3. *Act on Public Health* (Official Gazette RS", no. 72/2009) original title: *Zakon o javnom zdravlju* ;

4. *By – law on Establishment and management of drinking water source protection zones (O*fficial Gazette RS, no*. 9*2/08) original title: *Pravilnik o načinu određivanja i održavanja zona sanitarne zaštite izvorišta vodosnabdevanja.*

Both surface water and groundwater sources are addressed and delineation of the drinking water sources are for them are included in legislation framework. Several Ministries are implementing this legal framework, and local and regional authorities.

2 Water Act

The most important law regulating the entire water sector is the Water Act (OG Republic of Serbia No. 30/2010) that replaced the previous 1991 Water Act, amended by by-laws in 1993, 1994, 1996 and 2005. Actually this Act covers surface water and ground water, including drinking water, wastewater, thermal and mineral water, internal and transboundary water, and inland water bodies in Serbia. With respect to DWP PZ the Article 77 elaborates and regulates delineation of drinking water protection zones. In summary, 3 protection zones are required in Serbia. Different sectors are responsible for implementation e.g., water, health, environmental protection and spatial planning, among the others. Delineation is based on travel time, hydrology, hydrogeology, land use practices, etc. It is

3 By – law on Establishment and management of drinking water source protection zones

Requires the establishment of 3 protection zones for groundwater sources whose perimeter is defined using criteria based on the time of travel of water through the saturated zone (the maximum time it takes for a contaminant to reach the abstraction point). This is a widely used criterion that should provide confidence that the concentration of contaminants will have been reduced to an acceptable level.

Based on this by-law, physical protection of groundwater abstraction facilities must be provided in the 1st protection zone, in order to prevent rapid ingress of contaminants or damage to the wellhead. The 2nd protection zone is based on a minimum 50-day travel time (for porous aquifers), sufficient to reduce pathogens to an acceptable level that can be further removed in the treatment process. The 3rd zone is based on a minimum 200-day travel time (for porous aquifers), estimated to be needed for natural purification processes (dilution and effective attenuation of slowly degrading substances). This document underlines difference between aquifer types (porous, fissured and semi-confined aquifer), mostly based on different travel times. For karstic and fissured unconfined aquifers, the 2nd protection zone is based on a minimum 1-day travel time, and the 3rd zone covers whole catchment area. For confined karstic and fissured aquifers, the 2nd protection zone is minimum 500 m from water the water abstraction object, and the 3rd zone is minimum 1000 m.

It presents restrictions and prohibitions for both surface water and groundwater drinking water sources, with respect to aquifer type and category of surface water (lakes, open water courses).

Moreover the table of content and other relevant information for delineation report are comprehensively addressed in this by-law.

In summary, the main differences exist regarding the types of aquifer of surface water source category for the I and II DWS Protection Zones. Restrictions and prohibitions are almost the same for surface and groundwater sources. Document in Serbian language is available and attached to this report.

Finally, based on experts experience there is need for better implementation and clarification of: control, jurisdiction, compensation shame (indemnities) to land owners within the drinking water protection zones. In addition, penalties, monitoring, and implementation time are not well defined.

Serbian Report for DWS PZ Delineation – Belgrade, 06.07.2015.

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National legislation for delineation of drinking water sources protection zones- Albania

Water Supply and Sewerage Association of Albania (SHUKALB)

(FB11)

Tirana, May 2015

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INTRODUCTION

This Law aims at protecting and improving the water environment and water resources, ensuring their rational exploitation, fair distribution, protection from pollution, and set forth establishment of central and local institutional frameworks required to implement national policies of management and administration. Transitional waters in Albanian legislation are not considered as such. The legal framework on this issue is mostly considered as the management of all water types as well as the conservation and management of nature, protected areas, river basins, lakes, etc.

1.ALBANIAN CONSTITUTION

Approved in 1998, the Albanian Constitution establishes the general framework for the protection of environment, the use of sustainable development principle for natural resources management, as well as the right of everyone to have environmental information. So, in Article 59, “d” and “dh”, it is stressed:

“The state, within its constitutional powers and the means at its disposal, and to supplement private initiative and responsibility, aims at:

d. a healthy and ecologically adequate environment for the present and future generations;

dh. the rational exploitation of forests, waters, pastures and other natural resources on the basis of sustainable development principle;”

While Article 56 of Constitution states: “Everyone has the right to be informed about the status of the environment and its protection.”

2.LAWS AND REGULATIONS IN FORCE

Several laws are applicable in the area of water management.

The Law on Water Resources (No. 8093), which is also translated as Law on Water Reserves, regulates the conservation, development and utilization of water reserves, the distribution of water reserves and the protection of water reserves from pollutions (Article 1). It establishes a distinct system of permits, authorizations and concessions for different kinds of water use.

Standards for discharges shall be jointly determined by the NCW and the Ministry of Health and Environment Protection (nowadays consisting of two different ministries). It is unclear whether such discharge thresholds exist; there are no such standards in the Law Compendium. In March 2005 a Decision of the Council of Ministers "on the allowed limits of water discharges and the zoning criteria for the receiving waters" was adopted. According to the MoE, this by-law is directly related to the below mentioned Law No. 9115.

The Law on Water Supply and Waste Water Management (No. 8102), also issued in 1996, deals with securing a safe and reliable drinking water supply and domestic waste water treatment. The law introduces a compulsory licensing regime for companies wanting to distribute drinking water and collect and treat wastewater. The law establishes the national Water Supply and Sanitation Regulatory Commission under the auspices of the Ministry of Territorial Adjustment and Tourism.

The most recent Law on Environmental Treatment of Polluted Waters (No. 9115) addresses the treatment of polluted industrial and urban waters. The law establishes another license system on "requirements, terms and conditions for construction sites of plants and installations for water purification operations" (Article 18.2). Permissible norms of liquid discharges are to be determined by the MoE by means of a special decision.

Additionally, the Law on the protection of the marine environment from pollution and damage (2002) and the Law on the protection of trans-boundary lakes (2003) are to be named, too. Those laws shall protect the marine environment of Albania from pollution and damage, respectively the lakes at the border between Albania and its neighbours, manly by means of a management and control system and through the prohibition of a range of environmentally harmful activities.

2.1 Status of legislation, achievements, obstacles and needs

It is difficult to assess to which extent the various water laws are compliant with EU legislation. All laws described above establish definitions, principles and permitting and monitoring rules. On the other side, there remains the question whether in the field of water management and protection so many diverted laws and also competences of different governmental authorities are of any benefit.

Taken individually many of the laws are well written but they lack consistency and overall coherency. In some cases they are fragmented and overlapping. This seems especially true for the water sector where it is most obvious that there is no coherent legal system in place yet. None of the laws makes references to any of the other laws. Though there are a number of similar aspects addressed.

Even the LEP, which serves as a framework and should be the legal basis for all subsequent sectorial laws, is not mentioned anywhere.

So far, in Albania exist no water quality standards for water resources, neither for groundwater or surface water, nor coastal waters. The Environmental Law Compendium does not contain emission limits for waters either (in contrast for instance, to air pollution). Pursuant to Article 50.5 LEP standards shall be based on EU Directives, on the objectives of the national environmental policy and on the best available techniques. Drinking water standards, which exist since 1997, are oriented towards WHO standards.

The law on water resources provides for the collection of charges on discharged waters, but no charge levels have yet been established. On the other side, financial exemptions for persons who reduce their water consumption or discharges into water are also foreseen. The LEP in Article 25.3 additionally allows for imposing environmental taxes on discharges into water air and soil. For all instruments, details must still be regulated by special law.

The 1996 Law on Water Resources can be seen as a first attempt to introduce a sound and sustainable water management system based on EU principles and directives. However, in order to be put into practice, a number of procedural provisions and more relevant technical standards (thresholds, quality standards, charges, and other parameters) still need to be defined. All these lead to the conclusion that it would be highly beneficial to start a comprehensive reform of the existing water legislation regime in Albania.

Law no. 8934, dated 05.09.2002, "**On Environnemental Protection**", gives special attention to water protection, estimating it as one of the main environmental elements as well as a natural reserve. The fact that this law was approved in 2002, shows that there are obvious improvements in comparison with the first law on "Environmental Protection in Albania", of 1993. In this law the basic principles for the protection of environmental elements are to be found. So, in its article 11, entitled "Equal protection", it is stressed that: "Environmental constituents are protected and preserved separately from and closely linked with each other in their interaction and integrity. The protection of environmental elements includes the equal protection of quality, quantity and resources, proportions and processes among them".

3. WATER THAT REQUIRES PROTECTION

1. Water protection includes surface and ground waters, their sources, quality and quantity, beds and banks of surface waters and aquifer formations.

2. Water protection should ensure the prevention of the further destruction of the surface water quality and exceeding of the respective quality norms, recovering of contaminated surface water quality, and achievement of the water quality objectives, prevention of destruction of ground water quality, rehabilitation of the contaminated ground waters, improvement of the balance of extraction level and natural regeneration of ground waters, protection of water flora and fauna.

Another important element that is considered in this law, and it is relevant to legal definition, are the environmental criteria for the use of water resources. These criteria are the following:

1. The speed of natural flow, course of the flow, circulation, the bed and banks of waters can be changed only through maintaining appropriate ratio of the water biocenoses and ensuring conditions for its functioning.

2. The activities related with water use and especially with hydraulic and hydro technical interventions should ensure that waters:
   - Remain a landscape forming factor and cause no sliding and preserve water ecosystems
   - Are able to raise marine and terrestrial fauna and flora
   - Provide conditions for enabling their further use, from the qualitative and quantitative aspect.

3. Special protection will be provided for natural sources, which supply drinking water, waters used by food industry, waters used for mineral and medicinal use and other waters, which are significant for nature conservation as well as for recreational purposes and medical treatment use. The Minister of Environment through the specific cooperation with the Minister of Health, Minister of Industry and Energy, Minister of Agriculture and Food, Minister of Territory Adjustment and Tourism and Minister of Culture, Youth and Sports, will approve the criteria for the above categorization of waters and define the rules, procedures and measures for their use and environmental protection.

4. Water use, discharges into water and discharge of treated or untreated wastewater should endanger neither the natural processes conditions, nor the qualitative and quantitative regeneration.

5. Water extraction, its return to the waters of origin and the inter-basin transfer should not affect the reserves, should not change unfavourably the quality and biological assets of the water source and recipient environment and should not risk the water self-cleaning process.

6. The industrial activities that discharge waste water, should provide for stations for waste water treatment since project design and construct it before the activity becomes operational.

Law No. 9115, dated 24.07.2003, on **"Environmental Treatment of Polluted Water"**, represents a specific legal act that states the need for treatment of polluted water before it is discharged into the sea, preventing in this way pollution of transitional waters. As it is stated in the first article of this law, "The purpose of this Law is to protect the environment and human health from the negative impact of polluted waters by setting rules for environmental treatment of such waters and defining binding obligations upon subjects who discharge polluted waters in the environment". The scope of this law acts on:

- polluted urban waters,
- polluted industrial waters, according to specific industries;
- waters resulting from irrigation of the land;
- polluted waters of any kind

Regarding the technical and professional aspects, in this law all relevant terminologies are to be found, providing so a useful tool for the practical implementation of the law. All these terminologies have the same meaning and are in the same line with the legal international documents (different international Conventions) and EU Directives. So, in this law the following definitions are to be found:

- "polluted urban water" means used water discharged from households and certain industrial activities. Such waters contain both dissolved and float matter.
- "polluted household waters" means used water of any kind containing organic, degradable substances, mineral substances, dissolved or float, etc., discharged from plumping installations of all kinds.
- "polluted industrial waters" means used waters discharged from commercial and industrial activities.
- "receiving environment" means sites into which used waters are discharged.

- "agglomerate-intensive urban zone" means a zone into which the concentration of the population and economic activity necessitates the collection and systematization of discharged urban liquid waste into one single site or the channeling of such waters into a treatment establishment.
- "collector system" means a system of pipes, in one part or multipart, which collects and systemizes the discharged polluted urban and industrial waters.
- "unit for population" is the average pollution for person per day containing 90 gr/day of float substance, 60 gr/day organic matter, 15 gr/day ammonium nitrate and 4gr/day phosphorus.
- "primary treatment" means treatment of used waters through the physical process of primary decantation, which removes 60 per cent of float substance and 20 per cent of NBO5.
- "secondary treatment" means the treatment of polluted waters through biological processes, bacteria layers, aired basins, stimulated sedimentation coupled in particular cases with soluble action (decantation/filtration) to bring about de-nitration and de-phosphoration.
- "appropriate treatment" means the treatment of polluted urban waters through a given process as a result of which the liquid discharges in the receiving waters will not corrupt the quality of receiving water bodies as required by law.
- "sludge" is the solid and semi solid waste resulting from processes of treatment of polluted waters.
- "eutrophication" is the enrichment of water ecosystems with nutritious substances, containing primarily nitrate and phosphorus, especially such eco systems in which biological processes bring about a vigorous growth of algae and high forms of plant life generating changes in the quality of water.
- "estuary" means the transitory zone of water bodies at river deltas.
- "coastal waters" means the waters outside the line of low waters, or waters outside estuary boundaries.
- "biological need for oxygen NBO_5" means the amount of oxygen consumed over 5 days by aerobic bacteria in the presence of air. It represents biodegradable organic pollution.
- "sensitive zones" means zones forming part of naturally water lakes; water bodies destined to be utilized as sources of drinkable water; delta, estuaries and coastal waters that have been defined as eutrophic or are identified as potentially eutrophic.

- "less sensitive zones” means zones forming part of: open bays, deltas and coastal waters of satisfactory water movement and no risk of becoming subject to eutrophication or depletion of oxygen, or that are considered less prone to becoming eutrophicated as a consequence of discharge of polluted waters.
- "monitoring" is the collection, assessment and generalization of environmental data through continuous or periodic observation of a group of environmental indicators, both qualitative and quantitative, characterizing the environmental elements and their change under the influence of human or natural factors.

In the second chapter of this law, which is entitled “Prevention of water pollution and reduction of polluted waters”, the law defines its aims:

- reducing production of polluted waters by economic and social activities; reducing the scale of pollution in such waters;
- promoting the use of best possible techniques and methods based on environmental standards; endorsing by-laws and regulations setting such standards;
- instituting technical and technological safeguards binding upon subjects of this law;
- shortening the period of exposure of polluted waters to the environment;
- early environmental treatment so that subsequent treatment of polluted waters is not prevented;
- reducing to the greatest possible degree the movement of polluted waters; treating such waters closest to the source and at the closest possible cleaning plant;
- prevention of environmental pollution caused by polluted waters;
- ensuring identification of pollution damage and the rehabilitation of the environment from damage caused by physical and legal entities who discharge pollutants over and above prescribed norms.

In order to implement this law into practice, this law defines obligations that must be taken into consideration by physical or legal entities, whose activities use waters and discharge polluted waters:

1. Physical and legal entities, the activity of which discharges polluted waters, are obliged to take measures to:

a) continuously reduce the amount of used waters they discharge in the receiving environment;

b) reduce the degree of pollution in discharged waters, especially such pollution as caused by hazardous substances and waste;

c) manage and treat polluted waters by:

i) constructing and operating a system of internal pipes;

ii) constructing and operating treatment plants in accordance with specific requirements of the respective industry;

iii)constructing and operating a network of pipes to dispose polluted urban waters and industrial discharge into the collector;

iv) promoting the re-use of treated water;

v) treating sludge and solid waste resulting from treatment plants in accordance with requirements and conditions contained in the environmental license;

vi) implementing the legal norms for liquid discharge and using contemporary methods and technologies for treatment of polluted waters.

2. To comply with these obligations, the physical and legal entities whose activities discharge polluted waters must design a program of technical, technological and organizational measures. This program is subject to control by the Environmental Inspectorate, the licensing authority and the local government structures.

For the same aim and in the same line, the law defines which are the specialised developers that have to undertake the responsibility for polluted water treatment and defines, with more details, their tasks:

1. Physical and legal entities, public or private, national or foreign, that undertake the treatment and cleaning of polluted waters, must ensure:

a) the implementation of technical, methodological and organizational requirements for treating and cleaning polluted waters;

b) implementation of standards and conditions defined in the environmental license;

c) the discharge of treated waters in the receiving environment only if such waters comply with established norms;

d) the training of staff operating plants and installations for treatment and cleaning of polluted waters;

e) the administration of documentation recording the actions and processes carried out with relation to treatment and cleaning of polluted waters;

f) book keeping according to the division and classification of polluted waters with regard to quantities, content and cleaning of these waters;

g) treatment of sludge and solid waste resulting from treatment of waters in accordance with the requirements of solid waste management;

h) facilitation of inspector's control;

i) contract agreements with physical and legal entities, public or private, national or foreign, the activity of which produces polluted waters. These contracts define in detail the respective obligations.

2. Subjects treating polluted waters are responsible for damage caused to human health and natural environment. They are obliged to indentify the pollution damage and restore the environment to its former condition at their own expense. Rules and procedures for damage appraisal and rehabilitation of environment are defined by special ordinances of the Minister of Environment.

In this regard, and following the provisions of this law, the Council of Ministers approved the Decision No. 177, dated 31.03.2005, on "Permited norms for liquid discharges and criteria for environmental zoning of rivers or sea waters", which defines measurable and controlled discharges coming from the water treatment plant. This decision aims: to prevent, to decrease and to avoid rivers and sea waters pollution caused by hazardous wastes. Approval and implementation of these norms, which are the same as those applicable in the EU, represent a useful contribution to the national legal framework regarding water protection.

Another important element as regards the practical application is the fact that this decision defines criteria for environmental zoning of waters (rivers and sea), dividing them into sensitive and less sensitive waters, and following this sets special discharging regulations and norms for each case. The annexes to this decision relate to the monitoring programmes and how they have to be implemented, controlling bodies, etc.

4. THE PROTECTION OF TRANS BOUNDARY LAKES

Law No. 9103, dated 10.07.2003, this law represents one more successful initiative showing a special interest to water environment. This law is applicable for:

a) the Albanian part of Skadar lake;
b) the Albanian part of Ohrid lake;
c) the Albanian part of Prespa lakes;

And it aims at the environmental protection of the transboundary lakes in their natural state, guaranteeing the appropriate conditions for the development of life and ecosystems in these lakes, through the promotion of useful activities in compliance with the requirements of the sustainable development principle and stopping of activities that threaten them.

Further to this aim, unique ecosystems, with international values, such as the mentioned transboundary lakes, are specially protected by the state, and have been proclaimed as protected areas, according to laws no. 8906, dated 06.06.2002, on “Protected areas” and no. 8093, dated 21.03.1996 on “Water reseves”, as well as through international conventions ratified by Albania. (Now, all of them are proclaimed by Decisions of Councils of Ministers as protected areas, while Skadar lake is proclaimed as Ramsar site).

The environmental protection of the transboundary lakes is achieved through:

- strict enforcement of the relevant legal framework;
- implementation of sccientific, technical, technological, chemical, biological and statistical methods, which ensure the quality and quantity of the natural indicators of waters for the protection of biodiversity;
- development and implementation of the management plas, including all the environmental components and activities that will be implemented in waters, fishery, forestry, agriculture, tourism, communication and industry;
- development and implementation of the concrete monitoring programs;

- strict implementation of the requirements of the sustainable development principle;
- ensuring of and fruitful use of the financial means.

As these lakes have being traditionally exploited areas, the law allows use of the existing activities and other new activities only if these fulfil the requirements of sustainable development. In implemeting the requirements of sustainable development in the transboundary lakes, their shores and watersheds, the physical and legal persons, public or private, Albanian or foreigners, may undertake economical, commercial, tourist, social, scientific research activities, provided that they all are in compliance with the status of watershed protection and do not threaten biodiversity.

2.The activities mentioned can be undertaken only if:

a) they have obtained an environmental permit;

b) they are approved by the relevant central and local bodies;

c) they are undertaken in consistence with the requiremens of the watershed management plan.

The agricultural activities of the farmers that live in the territory of the lake watershed should take into account the requirements of the watershed management plan, particularly as regards land protection and use of chemicals.

Urban development and tourist constructions should be based on the local construction tradition and carried out in consistence with the requirements of the watershed management plan.

Transboundary lake waters can be used only in a controlled way and within the scientifically defined levels, without damaging the natural conditions and their biological and ecological balance.

The aims of the use, the quantities and usage regime for each concrete case should comply with the agreements with the neighbouring countries on lake problems.

The scientific research activities in transboundary lakes are implemented with the approval of the Regional Environmental Agencies (REAs) or of the Ministry of Environment. By a special regulation, the Minister of Environment classifies the scientific research activities that will be approved by the REAs and those to be approved by the Minister of Environment.

The scientific research institutes and other interested institutions or groups of researchers submit the activity programs they tend to undertake and on this base, the decision for the approval of the activity is issued.

At the end of the scientific research activity, a final report is prepared, a copy of which should be handed over to the Ministry of Environment, which respects the copyright and preserves the confidential character of the report.

Aiming to promote ecosystems protection, this law lists all activities that are prohibited in the transboundary lakes and in their watersheds:

- dumping or disposal of hazardous substances and wastes;
- untreated waste water discharges, urban, industrial, agricultural and human;
- depositing and dumping of wates of any kind;
- construction and use of waste and mining or processing industrial waste dumping sites close to them;
- cement constructions on the lake shores, which interrupt the multiple communications of the water with the land;
- construction of buildings, installations and any other enginneering platform in the shores or within the restricted area where construction is prohibited;
- excavation of sand, gravel and any other material from lake shores or shallow waters, as defined in the amended law no.8093, dated 21.3.1996, "On water reserves";
- opening of quarries, construction of lime ovens, installation of asphalt-cement plants close to urban areas and in sites, which damage the landscape of the zone;
- lake water exploitation without permitting and contrary to the conditions provided in the permit;
- uncontrolled cutting of trees and forests;
- inappropriate utilization and burning of pastures;
- undertaking of fishery and hunting activities not within the approved seasons and with means and manners prohibited by law;
- collection of medicinal, tarnipherous and ether-oil plants with prohibited means and methods and within the prohibited periods;
- collection of snails, frogs, tortoises, and reptiles with prohibited means and methods and within the prohibited periods;
- seizing of rare and endangered fish, animal and bird species for trading purposes;

- introduction to the lake and watershed of fish, animal, bird or plant species which are not endemic;
- The Council of Ministers, at the proposal of the Minister of Environment, may also approve the ban of other activities in the transboundary waters.

Special importance was given to monitoring and management of Transboundary lakes and their watersheds.

Transboundary lakes and their watersheds are subject to continuous monitoring, in order to control their quality and protect biodiversity.

- The monitoring program for transboundary lakes is part of the National Environmental Monitoring Program. It is prepared and impemented under the guidance of the Ministry of Environment, in cooperation with Directorate General of Forestry & Pastures (DGFP), Fisheries Directorate and other specialized agencies. There is a special program for each transboundary lake.

- The monitoring programs include:
    - identification of the indicators to be measured;
    - identification of measurement methods and methodologies;
    - frequency of measurements;
    - methods and methodologies of analyses and data review and processing to achieve scientific conclusions;
    - definition of rules and procedures for the monitoring expertise;
    - approval of registers, which reflect the monitorong data.

- Physical and legal persons that have received environmental permit for implementing activities in the lakes, their shores and watersheds are obliged to monitor their own activity, according to the monitoring program, register the data in their individual register and publish them not less than once in three months. The expenses for the monitoring of the activity are to be covered by the physical or legal persons concerned.

- The environmental Inspectorate and the administration for the protection of the zone, control the monitoring data register.

The management of transboundary lakes is carried out on the basis of the management plans prepared by the Ministry of Environment, in cooperation with relevant ministries, local government, research institutions and environmental non-profit organizations.

- The management plans of transboundary lakes include:
  - objectives of lake management;
  - identification of duties and responsibilites of various state bodies, research institions, environmental organizations and local communities for the management and protection of lakes;
  - threats from processes and activities;
  - measures to mitigate or reduce the identified threats;
  - permitted activities in the lakes, their shores and watersheds;
  - terms for tourism and other services controlling;
  - terms for the continuation of the traditional activities of the local inhabitants;
  - terms to share with the local communities the benefits from the management of lakes as protected areas;
  - terms for scientific research, inventory and monitoring;
  - financial sources, including those that generate income;
  - other special conditions for a certain lake.

The management plans should comply with the international conventions on the lake protection and management and they have to be in compliance with the agreements signed with the neigbouring countries.

- The conditions and criteria of the management plans are obligatory for all physical and legal persons, public or private, Albanian or foreign, whose activities are implemented in the watershed area. The lake administration, REA, Directorate of Forest Services, Directorate of Fishery, Water Authority and the DGFP, follow the implementation of the management plan requirements.
- The stakeholders are obliged to review and update the management plan no later that once in two years. They should notify the neighbouring countries for any change or amendment made.

An inventory of species and their habitats in the transboundary waters and watershed is prepared, so that they can be effectively protected from extinction. Based on the inventory, a program of action and measures for biodiversity and habitat protection is drafted and implemented.

The inventory is prepared under the supervision of the lake administration and with the participation of the specialised bodies and institutions and environmental non-profit organizations.

The Minister of Environment approves, with a specific regulation, the rules, criteria, methodologies and standard documents for conducting the inventory, which are prepared by the specialized scientific institutions.

5. INSTITUTIONAL ASPECTS FOR WATER PROTECTION AND ADMINISTRATION

During the period 1991-2005, water resources management was a complex matter because of the number of different sectors and sectorial ministries and other agencies involved. This complexity is to be found also in the respective provisions of the Water Resources Law. The institutional arrangements that it calls for can be summarized as follows:

5.1 National Water Council

The NWC was established pursuant to a decision of the Council of Ministers, of 25 November 1996, relating to the law's institutional arrangements. The current composition of the NWC, pursuant to Decision No. 458 of the Council of Ministers dated 3 October 2002, is as follows:

- the Prime Minister;
- the Minister of Territorial Adjustment and Tourism;
- the Minister of Finance;
- the Minister of Local Government and Decentralisation;
- the Minister of Industry and Energy;
- the Minister of Transport and Telecommunications;
- the Minister of Health;
- the Minister of Economy;
- the Minister of Agriculture and Food;
- the Minster of Environment.

The current NWC includes the main stakeholder ministries and as such offers a very high level forum within which water resources management issues can be discussed in an integrated manner. The NWC is chaired by the Prime Minister.

The law establishes the National Water Council as an apex body responsible for determining the main lines of policy and for making major decisions.

The tasks of the NWC are to:

- Propose draft laws and regulations for any kind of activity in the water resources field.
- Prepare the legal, technical and regulatory framework to implement this law, and, in addition, to draw up instructions and undertake other necessary actions for the application of the national plan on water resources.
- Approve and manage the drainage basin plans.
- Approve interregional and national plans and projects in the fields of agriculture, urban planning, industrial and territorial development, insofar as water conservation and management are concerned.
- Define the territorial boundaries of basin areas in all of the country and define the centre of each basin which will be the place where the register will be kept.
- Establish agencies or organisational units, which will depend on the Council, to facilitate the water resources management and application of this law.
- Propose and adjust appropriate measures for implementation of any international agreement or convention on water resources to which the Republic of Albania is a signatory.
- Approve concessions for water resources in cases stipulated by provisions of the Council of the Ministers. In cases where the water resources are of national importance, the concession will come into force only upon the approval of the Peoples' Assembly.

In addition, in accordance with article 6(2), the Council of Ministers is given the power to assign other tasks to the NWC as necessary.

Other tasks of the NWC are determined in the substantive parts of the WRL, such as, for example, the designation of different water use categories and the approval of designated areas of special protection.

5.1.1 Technical Secretariat

The Technical Secretariat (TS) is described in the WRL as the ‘executive agency’ of the NWC and is established on the basis of a decision of the Council of Ministers. Its tasks, described in more detail in article 7 of the WRL, are to:

- Implement the water resources national policy as approved by the National Water Council.
- Implement the provisions of this law.
- Draw up a central inventory of water resources in terms of their quality and quantity according to the rules of the National Water Council.

- Issue permissions and authorizations for water use pursuant to article 18 and discharges when such activity takes place beyond boundaries of one single basin.
- Encourage the participation of water users in the management and administration of water resources.
- Implement international agreements for transboundary water resources to which the Republic of Albania is a party.
- Prepare reports setting out options on all matters concerning water resources, and submit them to the National Water Council for approval. Ministries, research institutions and other state agencies will be obliged to answer within a due period of time to the inquiries of the Technical Secretariat for information, assistance and other necessary data for conducting studies and research.
- Promote research on the development of technical innovations with respect to the use, finding, exploitation, conservation, recycling, treatment, protection, administration and efficient use of water resources.
- Specify, in cooperation with research institutions, the fields of research and studies on water resources as well as the relevant funds needed.

These tasks are described in more detail in article 1 of the main regulation. This provides that the tasks of the TS are to:

1. Implement law no. 8093, dated 21. 03. 1996, “On water resources”, its sub-clauses, and decisions of the National Water Council.
2. Implement the water resources national policy as approved by the National Water Council.
3. Draw up the central inventory of water resources in terms of their quality and quantity according to the standards as stipulated by the National Water Council.
4. Prepare reports setting out options on all matters concerning water resources and submit them to the National Water Council for approval.
5. Issue permissions and authorizations for water use and discharges when such activities take place beyond boundaries of one single basin.
6. Promote the research on development of technical innovations with respect to development of water resources.
7. Encourage the participation of water users in the management and administration of water resources.
8. Examine financial plans prepared by the Water Basin Councils in terms of necessary financing for water resources.
9. Examine requests for use of water resources subject to the NWC approval (according to the classification approved by the Council of Ministers).

10. Prepare materials for the meetings of the NWC.
11. Specify, in cooperation with research, local or national institutions, the fields of research and studies on water resources as well as the relevant funds needed.
12. The Secretariat is not directly responsible for construction and functioning of hydro – technical works or equipment. It plays the role of a technical advisor, thus synchronizing water problems with financial solutions.
13. It recommend to the NWC the most important works to be constructed for each water basin, based on a national plan of operation and protection of water resources and priorities determined by the Law.
14. It analyses studies of Water Basin Agencies (the Agencies) on pollution of surface or ground waters in agriculture, industry, etc. Based on such analysis, the Secretariat proposes to the NWC national level projects and programs for reduction of pollution within boundaries specified by state standards.
15. The Secretariat implements decisions and international agreements on transboundary water resources, ratified by the Republic of Albania.
16. The Secretariat implements the tasks charged by the NWC.

The TS was established by a (separate) decision of the Council of Ministers of 25 November 1996. Actually, this Secretariat functions under the Ministry of Environment, Forestry and Water Administration (specifically, under the Directorate of Nature Protection Policies – as the Sector of Water Resources).

5.2 River Basin Councils and River Basin Agencies

The WRL enshrines the river basin principle and seeks to implement it through the establishment of River Basin Councils. These are described, in article 8 (1), as 'local authorities responsible for managing water resources in the relevant basins'.

Article 8 (2) states that:

A Basin Council shall be established on every river basin or group of river basins in the Republic of Albania within the limits deriving from international agreements. The basin councils will have legal personality and will depend on the Technical Secretariat of the National Water Council.

In accordance with article 8(3), the composition rights and duties of the RBCs are to be determined by the NWC. This was done in the main regulation, article 1(2) of which states that each RBC is to provide:

- A rational protection, development and operation of water resources within the boundaries of its own basin.

- Fair distribution within the boundaries of its own basin according to the purpose of the use and their effective administration.
- Protection of water resources against pollution, bad use and overuse (more than real needs require).

The main regulation describes the procedure for setting the agenda of RBC meetings and the 'usual' content of such agendas. These are:

- Approval of provisions and sub-provisions regarding implementation of Law no. 8093, dated 21. 03. 1996, "On Water Resources" (the plan of water resources, the financial plan, etc).
- Examination of requests for the use (discharge) of water resources in accordance with the classification approved by the Council of Ministers, decision no. 63, dated 26. 01. 2001, regarding competences for administration of water resources.
- Reports, information or discussion on other problems regarding the water resources.

The tasks of the River Basin Agencies are to:

1.1. Implement law no. 8093, dated 31. 03. 1996, "On water resources" and decisions of the Drainage Basin Council.

1.2. Prepare the plan for water resources within the boundaries of its basin and submit it to the DBC for approval and, after that, through the Technical Secretariat, to the NWC.

- Draw up the central inventory of water resources in terms of their quality and quantity within the boundaries of its basin.
- Encourage the participation of water users in the management and administration of water resources.
- Examine the fulfilment of financial responsibilities of water users (dischargers) of water resources.
- Examine financial plans in terms of necessary financing for water resources.
- Examine requests for use of water resources subject to paragraph 3 of this regulation.
- Prepare materials for the meetings of the DBC.
- Promote the research on development of technical innovations with respect to development of water resources.
- Prepare reports setting out options on all matters concerning water resources and submit them to the DBC or the Technical Secretariat of the National Water Council, as the case may be, for approval.

- Specify, in cooperation with research institutions, local or national, the fields of research and studies on water resources in the basin as well as the relevant funds needed and supervise the implementation of projects.
- The Agency is not directly responsible for construction and functioning of hydro – technical works or equipment. It plays the role of a technical advisor, thus synchronizing water problems with financial solutions.
- The Agency recommends the most important works to solve problems regarding water resources for communities, municipalities or prefectures in each water basin based on priorities determined by the Law.
- The Agency, in cooperation with local and central institutions, examines projects and programs for planning irrigation, drainage, river protection, lakes, etc. and submits them to the DBC for approval.
- Based on the hydrological and hydro-geological studies, it announces areas of sanitary protection around water resources and makes the respective decisions public.
- The Agency, in cooperation with specialized state and private institutions, carries out studies on pollution of waters in agriculture, industry, etc. Based on such studies, the Agency proposes to the DBC projects and programs for reduction of pollution within boundaries specified by state standards.

The main regulation also specifies the procedures for applying to the relevant River Basin Agency (RBA) for permissions, concessions and authorisations to use, or discharge wastes to, water. It also provides for the Agency staff, as well as persons authorized by the relevant RBC, to be appointed as water inspectors. Infringements of the WRL are to be reported to the economic department of the relevant RBA, which based on the inspector's recommendation, issues a fine. Such sanctions are to be applied in accordance with a decision of the Council of Ministers.

Six River Basin Councils have been established to date, based on the Vjosa, Semani, Shkumbini, Erzeni (and Ishmi), Mat, and Drin Basins. The RBCs, which range in size from 19 to 37 servants, were established in 2002.

As regards their composition, they are composed of officials from central and local government, being chaired by a Prefect. Most of the RBC members are water management experts or have a particular interest in water resources. In several basins, for example, the heads of communities or municipalities in which valuable water resources (such ground water resources) are included, as well as the Heads of the larger population centres, are members of the RBC.

6. REFERENCES

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9. Law no.9103, dated 10.02.2003, “On Protection of Transboundary Lakes”
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DRINK ADRIA

Adriatic IPA
Cross Border Cooperation 2007-2013

The project is co-funded by the European Union, Instrument for Pre-Accession Assistance

National legislation for delineation of drinking water sources protection zones in Bosnia and Herzegovina

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Defining of protection measures for drinking water sources and sanitary protection zones of drinking water sources has been determined according to the different laws and regulations in Federation of Bosnia and Herzegovina and Republic of Srpska.

Basic regulation which defines protection measures for drinking water sources and sanitary protection zones of drinking water sources in Federation of Bosnia and Herzegovina is **Regulation on defining conditions for determining sanitary protection zones and protection measures for public water supply water sources (Official Gazette of FBiH, no. 88/12)** (hereinafter: Rulebook FBiH) based on Article 66 paragraph 3 and according to the Article 220 paragraph 1 of the Law on Water (Official Gazette of FB&H, No. 70/06).

For the territory of Republic of Srpska, regulation which defines protection measures for drinking water sources and sanitary protection zones of drinking water sources is **Rulebook on the requirements method for defining and maintaining sanitary zones around water supply structures (Official Gazette of the RS, no. 7/03)** (hereinafter: Rulebook RS) based on Article 45 paragraph 8 of the Law on Water (Official Gazette of RS, No. 92/09).

In both aforesaid Rulebooks detailed conditions on the method of determining the sanitary protection zones of water which by the quantity and quality can be used or are used for public water supply population, or for human consumption;

Safety measures in the sanitary protection zones;

The procedure for the decision making on source protection.

In addition to the sources mentioned above, the provisions also apply to the sources of mineral, thermal and thermo-mineral waters intended for human consumption.

1. The decrees of this Regulation are not applied

Exceptionally, at the proposal of the municipal administration in charge of water on whose area is the source, the competent River Basin District Agency may allow derogation from the provisions of this Regulation:

if water is used exclusively for those purposes for which the water quality does not direct or indirect impact on human health;

if water is abstracted from a single source with an average daily capacity of less than 10 m^3 / day or if it is not a public water supply or commercial activities in order to ensure water supply of the settlements with less than 50 inhabitants.

II. CONDITIONS FOR DETERMINING SANITARY PROTECTION ZONES

(1) In accordance with both regulations (Rulebook FBiH and RS) terms of the way for determination of sanitary protection (hereinafter: the protection zone) are differ for (types of sources):

a) the source of groundwater in aquifers of intergranular porosity;

b) sources of groundwater in karst aquifers;

c) sources of water from surface water courses;

d) sources of water from the accumulation / lake.

2. Sanitary protection of sources

(1) For the protection of sources under Article 4 paragraph a) and b) of Rulebook FBiH establishes the minimum I, II and III protection zones for water sources under Article 4 paragraph c) and d) establish at least I and II Protection Zone referred to in paragraph 2 of same article.

(2) Subject to the provisions of the regulations for the protection of water sources are determined by four protection zones, as follows:

a) I protection Zone as the zone with the strictest prohibitions and restrictions;

b) II protection Zone as a zone with strict prohibitions and restrictions;

c) III protection zone as a zone of moderate prohibitions and restriction;

d) IV protection zone as the zone with preventive prohibition and restriction.

(3) The exact number, size and border protection zone referred to in paragraph (2) of same Article shall be determined in elaborate protection of sources on the basis of a risk analysis on the specific vulnerability of sources in relation to human activities taking place or are planned to take place in the source basin, which may directly or indirectly threaten the quantity and / or quality of water of those sources.

(4) If it shows justified, in the study of source protection can be established that:

a) The second and third protection zone referred to paragraph 2 of Article mentioned above may be in a whole or in certain parts of the basin treated as distinct sanitary protection zones;

b) within the II, III or IV protection zone referred to paragraph 2 of same Article restricted areas could be established, which will have more stringent restrictions and limitations of those set out in Annex 1 of Rulebook FBiH for the protection zone to additional safety measures for reduction of the potential risk of pollution.

(5) For all springs whose water is not intended for human consumption or for usage of underground mineral water sources, the Regulation provides establishing only the I protection zone with the strictest prohibitions and restrictions defined in Appendix 1 (Rulebook FBiH).

(6) For the sources referred to in Article 4 of same Regulation, which for its hydrogeological characteristics can be classified into two or more sources, the exact number, size and border of protection zones will be established in the Source protection elaborate based of a special researches carried out.

3. Determination of the water springs sanitary protection zones in the aquifers of intergranular porosity

(1) In order to prevent the entry of animals and unauthorized access of people, and sanitary protection zones water sources in the aquifers of intergranular porosity is formed around the intake areas, and includes a source, objects and space of possible artificial source recharge, regardless of the distance of the same from the water intake.

(2) The boundary of Protection Zone referred to in paragraph 1 of this Article shall be provided by a fence not less than two (2) meters, which is placed at a distance of not less than ten (10) meters from the external the contours of all objects that are in the water intake area.

(3) As an exception, depending on local conditions, distance limits of Protection Zone referred to in paragraph 4 (2) of this Article may be reduced to a distance of not less than three (3) m from the external contour of the intake area, provided that the appropriate investigation works and budgets established that:

a) there is no possibility of direct contamination of surface water sources on the immediate locality of the project, and the costs of land expropriation around the sources are extremely high, or

b) to the enclosure at a distance from the paragraph (2) shall require high investment costs.

(4) In exceptional cases, boundaries and buffer zones for water sources referred to in paragraph 1 of this Article can be expanded in order to protect the direct catchment of groundwater to prevent the transport of pollution from existing infrastructure facilities of public importance (Roads, railway, special facilities, etc.) That are already in proximity to the catchment. In these cases, extended the boundaries of I Protection Zone shall be determined on the basis of economic and technical arguments justifying this exemption, which will be presented in the study of source protection.

(5) Protection Zone II of the sources referred to paragraph 1 of this Article shall be established to reduce the risk of sources pollution by chemical substances of very high risk and other harmful impacts that may occur during the retention of water in the underground.

(6) Border of II protection zone of the source referred to paragraph 1 of this article delimits the field of external boundaries of I protected zone to the line from which the groundwater, assuming continuous extraction at the source of the maximum daily requirement of water supply the system needs at least ten (10) days of flow to the water intake.

(7) III protection zone sources referred to paragraph 1 of this Article shall be established to reduce the risk of groundwater contamination by pathogenic microorganisms and other harmful effects that may occur during the retention of water in the underground.

(8) Limit III protection sources zones referred to paragraph 1 of this article delimits the field of external border of II protection zone to the line from which the groundwater, assuming continuous extraction at the source of the maximum daily requirement of water supply the system needs at least fifty (50) days of flow to the water intake.

(9) IV protection source zone is determined primarily to reduce the risk of groundwater pollution by slow degradable chemical and radioactive substances.

(10) Border of IV protected areas of sources referred to paragraph 1 of this article delimits the field of III protection zone external borders up to the hydrogeological border catchment sources.

(11) In cases of extremely complex hydrogeological conditions on the field, the Client of elaboration of source protection may propose reducing or increasing of source protection zones areas as shown in paragraphs 6 and 8 of this article. This proposal, together with key explanation and suggestion of the planned program of works have to be delivered to the competent Agency for water area to provide expert opinion on the justification of such requirements as well as additional analyzes that study of water sources protection must contain.

4. Determination of the boundaries of water springs sanitary protection zones in karst aquifers

(1) In order to prevent the entry of animals and unauthorized access of people, the I Protection zone of the water source in karst aquifers is formed around:
a) karst springs and the associated water intake areas;
b) the abyss, sinking zones and pits within the hydrogeological catchment boundaries of the karst sources, which have been determined or estimated to allow drainage of the surface water to the karst springs in the period shorter than 10 days under the conditions of large discharge;
c) facilities intended for eventual artificial recharge of sources despite the distance of the same from the water intake.

(2) Border of the I Protection zone referred to in paragraph (1) of this Article shall be provided by a fence which is not lower that two (2) meters, which is placed at a distance of not less than twenty five (25) m contour of the outer water intake areas or outer contours of geological formation referred to in paragraph (1) indent b) of this article.

(3) As an exception, the boundaries of protected water source areas referred to paragraph (2) of this Article may be reduced at a distance of not less than ten (10) m, provided that the appropriate investigation works as well as monitoring the quality and quantity of water at the source and part of the basin to established that:

a) there is no possibility of direct surface contamination of water sources in proximity to the catchment, and the costs of land expropriation around the sources are extremely high, or
b) to the enclosure at a distance from the paragraph (2) shall require high investment costs.

(4) In exceptional cases boundaries of the I protected zones for water sources referred to paragraph 1 of this Article can be extended to prevent pollution from existing public significant infrastructure facilities (roads, railway, special facilities, etc.), which are in proximity to the catchment. In these cases expanded boundaries of the I protection zone will be established based on economic and technical argument that justifies this exemption, which will be presented in the study of source protection.

(5) In the cases referred to paragraph 4 of this Article, the source protection study will determine which part of the terrain must be enclosed as protection zone and for which part of the field can be possibly set up only a table with a warning about the vicinity of the source.

(6) Borders of II protection zone of the source referred to paragraph 1 of this article delimits the field of external boundaries I protected zone to the line from which the groundwater needs at least one (1) day of flow to the water intake.

(7) In exceptional cases, the II protection zone can be set up for those parts of the basin which are located outside the boundaries referred to in paragraph 6 of this article, in which the apparent speed groundwater flow of more than 2.5 km / day in conditions of high water.

(8) Borders of III protected zone of the source referred to paragraph 1 of this article delimits the field of external border of the II protection zone to the line from which groundwater takes at least ten (10) days of flow to the water intake.
(9) In exceptional cases, III protection zone may be established for those parts of the basin, which are located outside the boundaries of paragraph 8 of this article, in which the apparent speed of the flow groundwater ranges from 1.0 to 2.5 km / day in conditions of high water.

(10) Borders of IV protected area of sources referred to in paragraph 1 of this article delimit the field of external borders of III protection zone up to the hydrogeological border catchment sources.

5. Determination of the boundaries of sanitary protection zones sources with the water intake from open watercourses

(1) In order to prevent the entry of animals and unauthorized access of people, the I protection zone of the source with the catchment of water from open water courses shall be determined for the field in proximity around the intake area.

(2) Borders of I protection zone referred to paragraph 1 of this Article shall be determined at a distance of not less than twenty (25) meters from the outer contour of the intake area.

The same are marks as:

a) adequate buoys / floats on the river;
b) a fence not less than two (2) m on the banks of the watercourse.

(3) II protection zone of water sources referred to paragraph 1 of this Article shall be established to reduce the risk of watercourses pollution by chemical substances of very high risk. It encompasses part of the watercourses and belt coastal areas on both sides of the watercourse upstream from the border of I protection zones.

(4) Borders of II protection zone of the source referred to paragraph 1 of this Article shall be determined by the technical documentation of Source Protection in accordance with local conditions, wherein this border:

a) on the upstream side of the watercourse can not be less than one thousand (1,000) meters from the place water abstraction;
b) on both banks of the watercourse with a bandwidth of not less than fifty (50) m measured in the horizontal projection of the water level on the banks of which reach the watercourse during high waters frequency of 1/100 years.

6. Determination of the boundaries of sources sanitary protection zones with the water intake from the accumulation / lake

(1) In order to prevent the entry of animals and unauthorized access of people, the I protection zone of the source with catchment of water from the accumulation / lake determined to pitch directly around intake areas and accumulations / lakes.

(2) Borders of I protection zone referred to paragraph 1 of this Article shall be established around accumulation / lake at a distance of fifty (50) m, measured in the horizontal projection of the contours of water table, which is reached at the maximum elevation of the water level in accumulation / lake.

(3) Borders of I protection zone referred to paragraph 2 of this Article is referred to boards with prominent warnings on the protection measures the circumference of the accumulation / lake to a minimum within seventy (70) meters, measured in horizontal projection of the edge of the water accumulation / lake at the maximum elevation of the water level in the accumulation / lake. Tables are placed at a distance not greater than two hundred (200) meters.

(4) a water intake area of the sources referred to in paragraph 1 of this Article shall be determined by fence at least two (2) meters at a distance of at least ten (10) meters of external contour of the intake area.

(5) II protection zone of water sources referred to paragraph 1 of this Article shall be determined as a safety belt around I protected zones to reduce the risk of contamination of water in the accumulation / lake by chemical substances of very high risk.

(6) Borders of II protection zone of the source referred to paragraph 1 of this Article shall be determined by the technical documentation for source protection, where this limit could not be located less than one hundred (100) m of boundaries I protected zones, measured in horizontal projection. Depending on local situation, II protection zone can be in the study of source protection expand along the coast of watercourse - a tributary of the accumulation / lake.

III. ESTABLISHMENT OF SANITARY PROTECTION ZONES AND PROTECTIVE MEASURES

1. Protective measures in protection zones

(1) Measures to protect the water source protection zones are conducted through prohibitions, restrictions and other forms of control of human activities to reduce the risk of pollution sources or other influences that may adversely affect the water sources, their quantities, the quality and safety of water. For this purpose, by source protection elaborate activities in specific protection zones are determined:

a) prohibit completely;
b) permit to the implementation of standard measures of protection;
c) permit to the implementation of standard and additional measures of protection.

(2) The standard protection measures in Article 1. paragraphs b) and c) primarily include obligation of polluters to collect all your waste water by waterproof sewage system and to purified thus collected water to minimum secondary treatment purification.

(3) The list of activities and level of limitations of their application in individual protection zones is given in Annex 1 which is an integral part of Regulation FBiH.

(4) In all cases where certain activities are listed in Annex 1 of Regulation mentioned above shall implemented with standard or additional safety measures, and same have to be specified in detail in the Study of source protection. In most cases, additional safeguards will include the construction of an adequate sewer system with the facility for wastewater treatment specific to the present polluters, in order to prevent direct runoff or infiltration of wastewater into the underground.

(5) In exceptional cases, if the assessment of the overall risk in the Study of source protection determines that the implementation of standard and additional protection can not ensure adequate protection of water sources in case of implementation of some of the activities of Annex 1 of this Regulation, the Federal Ministry of Agriculture, Water and Forestry will inform the Government of the Federation of Bosnia and Herzegovina and request from the same a prohibition of the action or decision on the possible construction infrastructure facilities which will ensure adequate protection of water sources.

(6) To carry out the activities specified in Article 1. paragraph b) and c) above, the interested legal subjects and individuals must obtain water acts under the provisions of the Water Law (FBiH).

(7) The water supply system operator is obliged to enclose the area of I protected zone of source and highlights warning which prohibited unauthorized access and ensures permanent electronic and / or physical control.

(8) Access to confined areas within the I protected zone of source is only permitted to employed persons designated by the operator of the water system, the competent inspection authorities during the control performing, as well as other persons with special water supply system Operator's license and record, which specifies the general act on maintenance and usage of water structures referred to Article 20, paragraph 4 of the Water Law (FBiH).

2. Obligations of the competent municipal administration on the protection of water sources

(1) Municipal administrative body responsible for water on the territory where the source is located is obliged to, on the proposal of the water supply system Operator or independently, to do the following:

a) organize the preparation of the Study of source protection;
b) organizes the audit of Studies of source protection;
c) on the basis of the draft of Studies of source protection organizes and coordinate the public discussions;
d) submit the draft source protection studies for review and opinion of other units local governments on whose territory source protected areas are located proposed by elaborate;
e) refer to the competent authority under Article 68 paragraph 2 to 5 of the Water Law FBiH – proposal of "Decision on the protection of water sources" on implementation;
f) by users of springs for water bottling, mineral, thermal and thermo-mineral waters intended for human consumption prompted the establishment of source protection in accordance with the provisions of this Rulebook.

(2) The water supply system is obliged to ensure conditions for the implementation of activities Article 1. paragraph a) to e) of this Article, led by the municipal authority responsible for water.

3. The content of the Source Protection Study

(1) Study of source protection should minimally include:

1. project assignment certified by the contracting authority;
2. certified copy of the land registry excerpt for the area of source I protected zone;
3. general characteristics of water source basin;
4. geological and hydrological characteristics of the source basin with creating physical model and evaluation index of the geological and hydrogeological structures in relation to existing and planned activities in the water source basin (the Annex 1 to Regulation FBiH);
5. hydrological characteristics of the source basin;
6. vegetation characteristics of the water source basin;
7. characteristics of erosion processes in the source basin;
8. quantitative and qualitative characteristics of the water at the source during the hydrological cycle;

9. If the wells is a subject: optimal capacity wells, porosity aquifer, coefficient of filtration and transmissibility, the actual speed of groundwater, characteristic groundwater levels, the projected reduction of the water levels and dynamic water level in the well obtained during the well testing;
10. cadastre of existing and potential sources of pollution in the spring basin with depicting the types of pollution, estimation of the quantity of pollution and evaluation of pollutant index;
11. overview of results of additional research works;
12. overview of basic characteristics of water supply system (population number, water demand, system operation regime, etc.);
13. technical analysis to identify critical hydrodynamic and hydrogeological characteristics of the source basin with estimation of pollution index risk in order to determine the type and size of protection zones as well as defining the spatial coverage of individual protective zones;
14. identification of existing activities by individual protection zones and their specifications in accordance with the provisions of Article 10. paragraph 1 to 6 of this Regulation;
15. identification of protective measures for individual protection zones;
16. if necessary, proposal of rehabilitation interventions in existing buildings within the zones of sanitary protection;
17. water quality and quantity monitoring program at the spring,
18. estimation of costs for implementation of decisions;
19. conclusion on technical and financial justification of the implementation of source protection in comparison to potential alternatives;
20. preliminary draft of decision on the protection of water sources;
21. graphics draft of protection zones on the maps with corresponding proportions in which draft of I protected zone of source should be given a display of all water intake facilities.

(2) All data presented in the Study of protection must be processed using GIS technology, whose the databases must be consistent with the format of Water Information System (WIS) which has been established by the competent Water Agencies. The procuring entity of source protection elaborate shall subject data delivered to the competent Water Agency after implementation of decision for source protection.

4. Decision on water source protection

(1) Based on the approved Study of source protection by the competent authority under Article 68 paragraph 2 to 5 based on Law on Water makes the Decision on source protection.

(2) Pursuant to Article 66 paragraph 4 of the Water Act, the Decision on source protection needs that contains:

a) name of the competent authority and the legal entity responsible for the implementation of Decisions on protection source;
b) exact name and location of the spring;
c) topographic maps and copies of cadastral maps of proper proportions with delineation of boundaries of protection zones;
d) a detailed description of sanitary protection zones boundaries;
e) sanitary and other conditions of human activities implementations in certain zones of protection with a detailed description of protection measures, prohibitions or restrictions;
f) regulations on monitoring of the implementation of protection regime and protective measures;
g) regulations on quality and quantity monitoring of water at the source;
h) the sources and methods of financing the protective measures implementation for the planning period of at least ten (10) years;
i) deadlines for the implementation of measures;
j) criminal provisions.

5. Temporary protection of sources

For water sources of importance for the future: drinking water supply and the use of sources of mineral, thermal, thermo-mineral or other groundwaters, the temporary protection is under implementation in accordance with the provisions of Article 70 of the Law on Water.

IV. CROSS – BORDER MANAGEMENT OF WATER RESOURCES CUTAWAY BY A STATE BORDER BETWEEN BOSNIA AND HERZEGOVINA AND REPUBLIC OF CROATIA

1. Current state of regulations and agreements in cross – border sources management between Bosnia and Herzegovina and Republic of Croatia

Cross-border agreement on the regulation of water management relations between Bosnia and Herzegovina and Republic of Croatia is signed in July, 11th, 1996 in Dubrovnik, Republic of Croatia.

Contract defines regulation of mutually rights, obligations and responsibilities for usage of water resources from springs located at the territory of one state, and the same are used for water supply of population of another state. Aforesaid document starting from the implementation of a principle of rational water usage and respecting principle of equality and mutual benefit.

According to this Contract, it is established a special regulatory body **Commission for water management of Republic of Croatia and Bosnia and Herzegovina** (hereinafter: Commision). At September, 18th, 1996, at the first session of the Commission, it is addopted a special document **Rulebook of Commission for water management of Republic of Croatia and Bosnia and Herzegovina**. Document defined following segments:

- competence and work of the Commission;
- membership of the Commission;
- work and obligation of the Commission;
- procedures for making decisions and conclusions effectiveness;
- expenditures;
- special regulations;
- effectiveness.

Latest session (XX session) of Commission for water management of Republic of Croatia and Bosnia and Herzegovina was held on December, 16th, 2013 in Zagreb, Republic of Croatia. All propositions in the agenda are unanimously accepted at this session.

Most important conclusion at individual articles are:

Status of decision on initiating procedures for the conclusion of Contracts about the rights and obligations of water usage from public water supply systems separated by a state border.

6 References

Regulation on defining conditions for determining sanitary protection zones and protection measures for public water supply water sources (Official Gazette of FBiH, no. 88/12) Online available: http://www.fmpvs.gov.ba/texts/189_650_1214_b.pdf (5.6.2015)

Rulebook on the requirements method for defining and maintaining sanitary zones around water supply structures (Official Gazette of the RS, no. 7/03) Online available: http://www.vladars.net/sr-SP-Cyrl/Vlada/Ministarstva/mps/Documents/Pravilnik_o_mjerama_zastite_nacinu_odredjivanja_i_odrzavanja_zona_i_pojaseva_sanitarne_zastiete_p.pdf (5.6.2015)

Zakon o vodama FBiH (Water law) 2006 (Official Gazette of FBiH no. 70/06). Online available: http://www.fmpvs.gov.ba/index.php?user=84ce98abd1bd5628085b0c752403b234&sector=3 (5.6.2015)

Zakon o vodama RS (Law on water) 2006 (Official Gazette RS, no. 50/06). Online available:http://www.vladars.net/sr-SP-Cyrl/Vlada/Ministarstva/mps/Documents/Zakon%20o%20vodama.pdf (5.6.2015)

Institut za hidrotehniku Građevinskog fakulteta u Sarajevu – Sarajevo, June 2015

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DRINK ADRIA

Adriatic IPA
Cross Border Cooperation 2007-2013

The project is co-funded by the European Union,
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Montenegrian legislation for determination of drinking water source protection zones

Public Utility “Vodovod i kanalizacija”
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(FB14)

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1. INTRODUCTION

Montenegrin legislation relating to sanitary protection zones is determined by the following acts:

The basic regulation which defines protection measures for drinking water sources and sanitary protection zones of drinking water sources is Water Act (Official Gazette of Republic of Montenegro No. 27/2007, 32/2011, 47/2011 in Montenegrin: Zakon o vodama)

Regulation on methods for determining and maintaining sanitary protection zones for drinking-water sources and restrictions in the related zones, Official Gazette of MNE No. 66/2009), in Montenegrin: Pravilnik o određivanju i održavanju zona sanitarne zaštite izvorišta i ograničenjima u tim zonama). This Regulation prescribes the manner of determining the zones and belts of sanitary protection of sources that are used or can be used for drinking water supply, as well as restrictions in these zones.

2. DETERMINATION OF PROTECTION ZONES & RESTRICTIONS IN THESE ZONES

Determination of sanitary protection zones is carried out depending on the type of water source. Types of water sources in terms of this regulation are:

1. Groundwater sources in consolidated aquifers;
2. Water sources in karsts aquifers with the abstraction:
   - From the surface (catchment)
   - From the underground (wells, boreholes, tunnels, etc.);
3. Sources with surface water abstraction from:
   - Reservoirs and lakes
   - Open watercourses

With reference to the protection regime, sanitary protection zones of water sources are:

- Protection zones with a strict regime - Protection Zone I (immediate zone of protection);
- Protection zones with a limited regime - Protection Zone II (narrow zone of protection);
- Control zone- Protection Zone III (wider zone of protection).

1. Groundwater sources in consolidated aquifers

- *Protection zone I*

Protection Zone I of groundwater sources in consolidated aquifers shall be determined in order to protect water sources, water abstraction facilities and their immediate surrounding from water pollution and other negative impacts. The boundary of the first protection zone must be at least 10 m away from all the facilities for the abstraction of water.

The area of Protection Zone I may include, by using necessary protection measures, water intake and facilities for artificial recharging of groundwater, reservoirs, pumping stations, facilities for improving water quality, chambers for pressure interruption, power substations, commercial buildings, access and internal roads and other facilities that are necessary for the operation of drinking water supply facilities.

Only activities related to the exploitation, treatment and transport of water in water supply systems may be carried out within sanitary protection zone I.

In the first zone of protection the access is only allowed to persons working at facilities in that zone and competent inspectors, while the others must have the permission of the owner or user of the drinking water supply facilitz.

The area of Protection zone I must be protected from an unauthorized access by a protective fence.

The user of water intake must appropriately mark a Protection zone I and put a notice prohibiting an unauthorized access.

- *Protection zone II*

Protection Zone II is determined to reduce the risk of radiological, chemical, biological and macro-biological and other possible groundwater contamination and other adverse impacts that may occur at the source.

The boundaries of the Protection zone II zone depend on the yield of water sources including:

- For water sources whose yield is <10 l / s, the boundary line is located at a distance of 10 m from the boundary of the Protection zone I,
- For water sources whose yield is > 50 l/s, the boundary line is located at a distance of at least 50 m from the borders of the Protection zone I; which is determined according to the geological composition of the terrain and potential contaminants.

Within Protection zone II it is prohibited to perform works, construct objects and carry out activities which can pollute water sources, particularly:

- discharging untreated wastewater; waste disposal, including disposal to sanitary landfills;
- construction of chemical industrial plants;

- building roads without a system of controlled discharging and treatment of storm water,
- surface and underground exploitation of mineral resources
- agricultural production, other than production without the use of artificial fertilizers, pesticides and herbicides (healthy food production);
- animal production, except for the own needs of a household
- construction of facilities for production, storage and transport of dangerous substances;
- construction of a cemetery and the expansion of existing one
- construction of industrial plants dangerous for the water quality,

The user of water intake must appropriately mark a protection zone II and put a notice of the water source protection zone.

- *Protection zone III*

Protection Zone III is determined to reduce the risk of groundwater contamination by difficult degradable substances and radioactive and chemical substances.

The area of zone III includes the area outside the boundary of zone II, up to the boundary determined by the conditions of exploitation of a water source and possibilities of its pollution.

Within Protection zone III it is prohibited to perform works, construct objects and carry out activities which can pollute water sources, especially:

- discharging untreated wastewater; waste disposal, except disposal to sanitary landfills;
- building roads without a system of controlled discharging and treatment of storm water,
- construction of industrial and other facilities whose wastewater and other waste products from the technological process can pollute water source.

2. Water sources in karsts aquifers

Due to specific characteristics of karsts aquifers, that is specific characteristics of underground water courses and water regime of karsts aquifers, the determination of sanitary protection zones and protection measures for water sources in these aquifers is done by using a selective approach to protection, which is in line with the plans of sustainable development, with the aim of reducing the risk of pollution of karsts aquifers. In doing so, the following should be taken into account: the time of possible transport of pollution, aquifer regime, the way of charging and discharging of aquifers, especially in relation to the previous position and state of aquifers.

- *Protection zone I*

With reference to defining, maintenance and limitations in Zone I of the protection of water sources in karsts aquifers, the same provisions as for the Protection Zone I of groundwater sources in a consolidated aquifer are applied.

- *Protection zone II*

The area of Protection zone II for karsts springs is formed around the Protection Zone I and covers an area from the border of protection zone I to the outer border of the Protection zone II.

The outer borders of the Protection zone II for water sources in karsts aquifers with water abstraction from the surface (catchment) are determined in accordance with the amount and the regime of exploitation, hydro-geological characteristics of the terrain and the basin and possibilities of pollution of the aquifer where the source is.

The outer border of the Protection zone II for water sources in karsts aquifers with water abstraction from the underground (wells, boreholes, tunnels, etc.) is the line from which, according to research work, it has been estimated that contaminated water can get into the zone of influence the aquifer.

The same provisions are applied to the Protection zone II for water sources in karsts aquifers as for the Protection zone II in consolidated aquifers.

- *Protection zone III*

The area of Protection zone III covers an area from the outer border of the Protection zone II to the hydro-geological watershed of a karsts spring.

Within Protection zone III it is prohibited to perform works, construct objects and carry out activities which can pollute water sources, especially:

- economic and other activities that harm the natural regime of recharging underground water sources, if it does not provide special measures for artificial feeding in an amount sufficient to compensate for lost quantities;
- discharging untreated wastewater;

- waste disposal, except disposal to sanitary landfills,
- building roads without a system of controlled discharging and treatment of storm water,
- construction of industrial and other facilities whose wastewater and other waste products from the technological process can pollute water source.
- storage of oil and oil derivatives,
- storage of radioactive and chemical materials;
- construction of a cemetery and the expansion of existing one,
- other activities for which it is established that can have negative effects on karst springs.

3. Sources with surface water abstraction

3.1. Abstraction from reservoirs or lakes

- *I Protection zone*

Protection Zone I is determined to protect reservoirs or lakes and water abstraction facilities from pollution and other negative impacts.

Protection Zone I consists of reservoirs or lakes, dams, pumping stations, water treatment plants, facilities for the operation, maintenance and storage, protective clarifiers at the mouth of the inflow and a protective belt along the reservoir or lake, with a width of 30 meters from the edge of water at a normal backwater level.

The following must be fenced within Protection zone I: water intakes, pumping stations, water treatment plants and facilities for operation and storage; a warning against unauthorized access must be placed as well.

Within Protection zone I it shall be prohibited:

- performing works, construction and carrying out of economic and other activities other than activities required for water abstraction, treatment and transport of water in the water supply systems,
- waste disposal, untreated waste water discharge,
- storage of oil and oil derivatives,
- construction related to the storage, handling, processing, transport and disposal of radioactive and other hazardous substances,

- building roads without a system of controlled discharging and treatment of storm water,
- exploitation of mineral resources,
- construction of industrial plants dangerous for the water quality,
- animal production;
- livestock watering,
- use of fertilizers and plant protection products,
- construction of a cemetery and the expansion of existing one,
- public transport of vehicles and pedestrians,
- using of all types of vessels, water sports and swimming,
- fishing and sport fishing, fish farming,
- construction of other facilities that may endanger water quality.

- *Protection zone II*

Protection Zone II is determined to protect reservoirs or lakes from pollution that may arise from permanent and temporary inflows.

Protection Zone II consists of a belt with the width of at least 50 m on each side of the inflow, measured from the border of Zone I, and extends along the flow up to the border area of the basin of a reservoir or lake; it also includes a 100 meter wide belt along a reservoir or lake measured from the border of Zone I.

Within II protection zone it shall be prohibited:

- waste disposal except disposal to the sanitary landfill,
- discharge of untreated waste water,
- storage of oil and oil derivatives,
- construction related to the storage, handling, processing, transport and disposal of radioactive and other hazardous substances,
- building roads without a system of controlled discharging and treatment of storm water,
- exploitation of mineral resources,
- construction of industrial plants dangerous for the water quality,

- agricultural production, except for a limited application of fertilizer and easily degradable pesticides;
- animal production, except for the own needs of a household,
- construction of a cemetery and the expansion of existing one,
- construction of other facilities that may endanger water quality.

The user of water intake must appropriately mark a protection zone II and put a notice of the water source protection zone.

- *Protection zone III*

Protection Zone III is determined to protect reservoirs or lakes from the impact of the area in its basin.

Protection Zone III is determined for reservoirs and lakes with no developed surface hydrographic network but with characteristic surface storm water runoff.

Protection Zone III consists of a belt from the boundary of protection zone III to the outer boundary of the basin.

3.2. Abstraction from open watercourses

For water abstraction from open watercourses only Protection Zone I is determined. The borders of Protection Zone I cover an area of direct water abstraction in the bed of the watercourse, river banks, pumping stations, treatment plants and facilities for the operation, maintenance and storage, as well as the opposite bank, if the waterbeds of low water are narrower than 20 m.

The boundary of Protection Zone I must be at least 10 m far from all facilities for abstraction.

The area of the first protection zone must be protected by fencing, .i.e. by setting floating marks at the watercourse, as well as displaying a warning against an unauthorized access.

Within Protection zone I it shall be prohibited:

- performing works, construction and carrying out of economic and other activities other than activities required for water abstraction, treatment and transport of water in the water supply systems,
- waste water discharge from production buildings and water for washing treatment facilities,
- use of fertilizers and plant protection products,

- using of all types of vessels, anchorage, water sports and swimming, fishing and sport fishing,
- livestock watering,
- public transport of vehicles and pedestrians,
- deepening of riverbeds and the extraction of gravel and sand.

3.3. Abstraction from the sea

For the abstraction of water from the sea for the purpose of desalination of water only Protection Zone I is determined.

The boundary of Protection Zone I must be at least 10 m far from all facilities for abstraction.

The area of the first protection zone must be protected by fencing, .i.e. by setting floating marks at the sea, as well as displaying a warning against unauthorized access.

Within Protection zone I it shall be prohibited:

- performing works, construction and carrying out of economic and other activities other than activities required for water abstraction, treatment and transport of water in the water supply systems,
- using of all types of vessels, anchorage, water sports and swimming, fishing and sport fishing , fish farming.

III BELTS OF SANITARY PROTECTION & LIMITS

The belt of sanitary protection is determined around the main pipelines and, depending on the configuration of the terrain, it is 2 m from the pipeline axis on both sides, and for water supply pipelines for up to 200 inhabitants it is 1 m from the pipeline axis on both sides.

References

[1] Water Act (Official Gazette of Republic of Montenegro No. 27/2007, 32/2011, 47/2011

[2] Regulation on methods for determining and maintaining sanitary protection zones for drinking-water sources and restrictions in the related zones, Official Gazette of MNE No. 66/2009)

Croatian legislation for determination of drinking water protection zones

Rijeka, May 2015

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WP4.4 Report:

National Legislation for Water Protection Zones - Greece

Civil Engineering Department
University of Thessaly, Greece

Volos, 2015

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1 Introduction

This report refers to the legislation on Water Protection Areas and Zones in Greece. The EU legislation (article 7 of the WFD 2000/60/EC) requires from the Member States to identify the water bodies used for the abstraction of water for human consumption providing more than 10 m^3 a day as an average or serving more than 50 persons, and those bodies of water intended for such future use in each river basin district [1]. The same article states that the objectives of article 4 must be met and that the resulting water should be in accordance with the requirements of the Directive 98/83/EC regarding water quality [1]. Article 7.3 states that member states can establish safeguard zones as a measure for the protection of the water bodies used for the abstraction of water for human consumption and avoid deterioration in their quality [1].

WFD's Guidance Document 16 asks from the Member States to establish safeguard zones to ensure the necessary protection of the drinking water protection areas [2]. However the establishment of such zones is at the discretion of Member States. The size of a safeguard zone could therefore vary according to: hydrogeological properties of the aquifer (porous, karstic aquifer); the size of the abstraction for human consumption; the type of pollutant and the sources of contamination for which protection measures are necessary; and the vulnerability of the aquifer [2].

2 Greek Legislation for the Water Protection Zones

2.1 Law 3199/2003 (Official Gazette 280/9.12.2003)

Greek legislation includes the Law 3199/2003 issued to harmonize the WFD 2000/60/EC to the Greek legislation. According to the WFD (article 6 and annex IV) the protection areas are identified as follows [1,3]:

- Areas intended for water abstraction for human consumption (Article 7);
- Areas intended for the protection of aquatic species of economic significance;
- Aquatic systems characterized as recreational waters (including bathing waters);
- Areas sensitive to the presence of nutrients including zones characterized as vulnerable;
- Areas intended for the protection of habitats or species when the water status preservation or improvement is significant for their protection (including Natura 2000 sites).

According to this article the Water Directorates compile the Registry of Protected Areas for each River Basin District. These local registries will be used to compile the National Registry of Protected Areas [3].

2.2 Presidential Decree 51/2007 (Official Gazette 54/8.3.2007)

To implement the national law 3199/2003 the Presidential Decree 51/2007 has been issued. The article 7 of the PD51/2007 refers to the water systems used for the abstraction of drinking water. The article states that the competent Water Directorates along with the approval of the Health Directorates identify [3]:

- the water systems used for water abstraction intended for human consumption and supply more than 10 m^3 per day (average) or serving more than 50 persons;
- the water systems intended for such use in the future.

Water systems supplying more than 100m^3 water per day should be monitored. According to this article every water system subject to this article should [3]:

- Fulfill the environmental objectives of article 4; and
- Fulfill the quality standards of article 13.

The Water Directorate and the Health Directorate of each Regional Authority have the responsibility for the compliance with the legislation regarding the quality of drinking water and ensure the protection of the identified water bodies [3].

It is possible that safeguard zones can be identified with the decision of the General Secretary of the Region. With the same decisions when it is necessary terms, prohibitions and restriction for activities and uses can be applied.

2.3 Joint Ministerial Decree Y2/2600/2001 (Official Gazette 892/11.7.2011)

Joint Ministerial Decree Y2/2600/2001 is issued to harmonize the Directive 98/83/EC regarding water quality in the Greek legislation. Article 11 of this decree states that it is necessary to take the necessary measures for the protection of the water abstraction sources for drinking water [4]. These measures include protection or safeguard zones [4].

2.4 Health Provision E1β/21/65 (Official Gazette 138/b/24.2.1965)

This document sets the security distance of the water abstraction sources from the sewage disposal sites. Paragraph 1.1 of the article 4 has been replaced by the Joint Ministerial Decree 46399/1352 setting three categories of surface waters intended for drinking purposes and their qualitative characteristics.

2.5 Health Provision A5/2280/85 (Official Gazette 720/B/213.12.1983)
This document sets protection issues of the water abstraction sources used for the water supply of Athens. Protection zones are identified and restrictions are set.

2.6 Joint Ministerial Decision 39626/2208/E130 in accordance with the Groundwater Directive 2006/118/EC (Official Gazette 2075/25.9.2009)
The groundwater directive refers to the protection of the groundwater bodies from pollution and degradation. This directive complements the WFD in determining the quality status of the groundwater bodies.

The Greek JMD 39626/2208/E130 determines the measures for the protection of the groundwater bodies from pollution and degradation.

2.7 Joint Ministerial Decree 43504/2005 (Official Gazette 1784/20.12.2005)
This Decree sets the prerequisites for water use permits and water resources utilization works. It determines the procedure and the necessary documents. It also determines the water uses and the basic categories of water resources utilization works.

2.8 Decrees issued by the Secretary General of each Region regarding the enforcement of restrictive and prohibitive measures in water uses and operation of water resources utilization works and prerequisites determination for the water use permits issuance and the protection of the water resources of the River Basin Districts
Each Secretary General of the Region can issue decrees to apply restrictive and prohibitive measures regarding the water uses and the water resources utilization works. These decrees may refer to all the water resources of a Region or of a regional unit. Specifically these decrees include:

- Prohibitive measures: they are general or they refer to a specific area delimited in the decree
- Restrictive measures: they refer to minimum distance of water intake works from pollution sources, roads etc. They refer both to drinking water and irrigation water
- Regulatory issues
- Monitoring and implementation control
- Documentation
- Sanctions
- Exceptions

For Corfu the related Decree is published in the Official Gazette 150/17.2.2010.

3 Methodology for determining water protection zones

For the zones of water intake it is necessary to adopt safeguard zones. The protection measures should ensure that the water quality in the intake point is not downgraded taking into consideration the water volume intake, the hydrogeological conditions and the vulnerability of the aquifer, the kind of pressures set etc. The safeguard zone is part of the groundwater body. The boundaries of the zones and their protection measures are identified according to the hydrogeological conditions.

According to the National legislation and the River Basin Management Plans the safeguard zones differ depending on the specific case [5]. The location, the boundaries and the size of the safeguard zones depend on the hydrogeological, hydrodynamic and hydro chemical conditions of the zone of water intake, the land uses and the vulnerability of the aquifer. The protection measures of the water intake area differ in granular formations from the karstic ones [5].

A water intake work safeguard zone adopts the whole area that must be protected in such a way that pollutants in dangerous concentrations will not reach the area and will not be abstracted [5].

The safeguard zone is also determined according to the position of the water intake work in relation with the hydrogeological boundaries of the aquifer. The geometry, the area and the depth of the formation are important as well as the abstraction flows from neighborhood drillings, the proximity with zones of different permeability etc. The geometry of the safeguard zones is not circular except of extremely idealized conditions. The hydrological status should be explored and the safeguard zones should be determined accurately taking into consideration all the factors affecting the movement of the groundwater. The factors vary and thus the safeguard zones cannot be static characteristics of the aquifers [5].

The protection perimeter includes three zones [5]:

Zone III (distance or surveillance zone). This zones safeguards the protection from chemical non degradable or difficult degradable pollutants. The storage and transport of pollutants; the establishment of polluting industries; the establishment of large livestock farms without measures of treatment and protection; the establishment of refineries; the establishment and operation of hospitals where there are no protection measures for the soil pollution and the groundwater systems with the operation of wastewater treatment plant; the operation of waste dumps are not allowed in this zone. Zone III extends from the boundaries of the supply basin of the water intake work to the outer boundaries of zone II. The range of zone III depends on the kind of the aquifer (karstic, granular), if it is free or under pressure, the geological layers of the aquifer, the grassing, etc.

Zone II (nearby protection or controlled zone). This zone protects drinking water from microbiological pollution and the pollution from human activities and installations being dangerous due to the neighborhood with the water intake. It is also characterized as zone of 50 days. The intensive agricultural activities; the livestock farming; the operation of quarries, borrow pits etc.; the mining activities; the outdoor storage of fertilizers and pesticides; the worksites; the transport of radioactive material and pollutants etc. are not permitted in this zone. In the agricultural zone the controlled use of fertilizers and pesticides is necessary. The monitoring network controls possible pollution and depending on the results measures are taken, when necessary.

Zone I (strict protection or prohibited). This zone protects the direct environment of the water intake from pollution. This zone is characterized as zone of full prohibition. The zone should extend at least 10-20m around the water abstraction works and at least 10-20m upstream the springs. The zone range is determined from the permeability and the hydraulic slope of the aquifer determining the length of the groundwater route and thus the route of the pollutants for 24 hours. The zone is fenced. The circulation and the passage of people is prohibited except of the authorized personnel. The agricultural activity, the use of pesticides and manure is also prohibited. Cementation around the drilling, cementation or sealing by other means during the construction and the pipeline installation higher than 3m of the drilling are necessary works to avoid the inflow of surface waters inside the aquifer through the water intake work.

In the groundwater systems, safeguard zones can also be determined beyond the zone of 10-20m around the strict protection point:

For karstic systems: 600m upstream (of the supply zone) and 200m downstream the points of drinking water abstraction because of the existence of groundwater recession cone during the abstraction. There are differences depending on the karstification grade.

For granular systems of free flow: 400m upstream (of the supply zone) and 150m downstream the points of drinking water abstraction because of the existence of groundwater recession cone during the abstraction. Significant aquifers are developed without protection from low permeability layer.

For granular systems under pressure or partially under pressure: 200m upstream (of the supply zone) and 80m downstream the points of drinking water abstraction because of the existence of groundwater recession cone during the abstraction. The development of impervious horizon protects the aquifer. The development of further aquifers with small independence makes difficult the route of the pollutant substances.

For fracture systems: 400m upstream (of the supply zone) and 150m downstream the points of drinking water abstraction.

The principal determination of these safeguard zones refers to the protection zone II.

All this information is provided in the River Basin Management Plan of Water District of Epirus [5].

4 Measures used for the protection

Water body type	Zone	Passive Measures
Groundwater & springs	Zone III (distance or surveillance zone)	It is prohibited: • The storage and transport of pollutants; • the establishment of polluting industries; • the establishment of large livestock farms without measures of treatment and protection; • the establishment of refineries; • the establishment and operation of hospitals where there are no protection measures for the soil pollution and the groundwater systems with the operation of wastewater treatment plant; • the operation of waste dumps
Groundwater & springs	Zone II (nearby protection or controlled zone)	It is prohibited: • The intensive agricultural activities; • the livestock farming; • the operation of quarries, borrow pits etc.; • the mining activities; • the outdoor storage of fertilizers and pesticides; • the worksites; • the transport of radioactive material and pollutants
Groundwater & springs	Zone I (strict protection or prohibited)	All activities are prohibited including: • passage of people (except of authorized personnel); • agricultural activities; • use of fertilizers and pesticides and manure. Excluded activities (case by case) are: • existing works operating legally; • works under construction; • works with approved environmental conditions; • works with installation or operation permit still examining the local hydrogeological conditions and the construction characteristics of the water intake work.

5 Drinking Water Protection Zones in Corfu

5.1 Identification of Water Protections Zones in Corfu Island

As identified in the River Management Plan of the Water District of Epirus one groundwater system is identified as protected area for drinking water (GR0500010) (Figure 1) [6]. This system is used for drinking water supply for the municipality of Corfu.

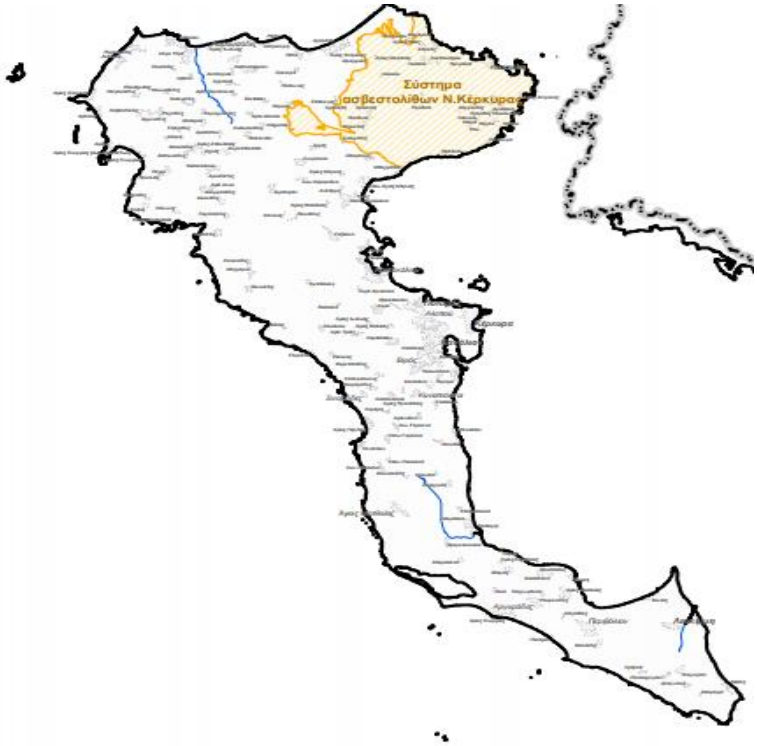

Figure 1. Protected areas for drinking water [6]

5.2 Proposed measures for drinking water (Article 7 of the WFD) for the Water District of Epirus

Several measures are identified for the protection of drinking water (article 7 of the WFD). Such measures included in the River Basin Management plan of Epirus are [5]:

Measure WD05B200

Title: Prohibition of drilling of new boreholes in:

- Water systems being at bad quantity status;

- Zones of 200m from the sea shore;
- Within the zones of the collective irrigation networks;
- In the safeguard zones (I and II) of the springs and the drinking water boreholes except of specific cases (water supply etc.) examined by the Water Directorates with the submission of hydrogeological report.

Description: in the water systems that are identified to be in bad quantitative status, in the coastal zones of the collective irrigation networks and in the drinking water protection zones new boreholes must be prohibited to avoid further deterioration of the status and to protect the collective irrigation networks and the drinking water points. Only in special cases (e.g. drinking water supply) a permission could be given for a new borehole after the submission of hydrogeological report and approval of the Water Directorate.

Measure WD05B210

Title: In principle determination of safeguard zones for groundwater intended for drinking purposes.

Description: In principle determination of the safeguard zones for abstraction points of groundwater intended for drinking depending on the kind of the aquifer as follows:

- Zone of absolute protection I: 10-20m around the abstraction point;
- Protection Zone II:
    - Karstic systems: 600m upstream (the supply zone) and 200m downstream the abstraction points of drinking water
    - Granular systems of free flow: 400m upstream (the supply zone) and 150m downstream the abstraction points of drinking water
    - Granular aquifers under pressure or partial pressure: 200m upstream (the supply zone) and 80m downstream the abstraction points of drinking water
    - Fracture systems: 400m upstream (the supply zone) and 150m downstream the abstraction points of drinking water.

Measure WD05B220

Title: Reporting or updating the Master plans of the Water Utilities.

Description: Preparation of General Master plans for drinking water supply where the water resources covering the drinking water needs in midterm and long-term will be identified. The necessary protection measures will be adopted in time and the external water supply networks will be designed. It is proposed that the Masterplans will be prepared by the water utilities as they are the competent authorities. The water needs not covered today from a water utility will be included.

Measure WD05B230

Title: Amendment – update of regulatory decisions for prohibitive, restrictive and other measures targeting to the protection and management of the water potential based on the programme of measures of the River Basin Management Plan (RBMP).

Description: Updated decrees issued from the Secretary General of the Region taking into consideration the data from the RBMP. The decree will include prohibitive, restrictive and other measures for the protection and the management of the water potential.

References

[1] Directive 2000/60/EC of the European Parliament and of the Council, available at: http://eur-lex.europa.eu/resource.html?uri=cellar:5c835afb-2ec6-4577-bdf8-756d3d694eeb.0004.02/DOC_1&format=PDF

[2] CIS Guidance document N.16: Groundwater in drinking water protected areas, available at: https://circabc.europa.eu/sd/a/aef48d98-7715-4828-a7ee-df82a6df4afb/Guidance%20No%2016%20-%20Groundwater%20in%20DWPAs.pdf

[3] Presidential Decree 51/2007 available at: http://www.ypeka.gr/LinkClick.aspx?fileticket=5fyCnT46Wg8%3D&tabid=248&language=el-GR

[4] JMD Y2/2600/2001 available at: http://www.elinyae.gr/el/lib_file_upload/b892_2001.1127472533032.pdf

[5] https://dl.dropboxusercontent.com/u/50953375/KeimenaTekmiriosis/13o_Paradoteo.pdf

[6] River Basin Management Plan of the Water District of Epirus, https://dl.dropboxusercontent.com/u/50953375/RBMP_GR05.pdf

National Legislation for Water Protection Zones - Greece – Volos 15.05.2015

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Cross Border Cooperation 2007-2013

The project is co-funded by the European Union,
Instrument for Pre-Accession Assistance

Workpackage 4

Activity 4.4 Water (re)sources protection and cross border water (re)sources management

Drinking Water Protection Zones

ANNEX 2

Overview of drinking water protection measure in IPA region from countries involved in the project

Action/Category	ITALY	SLOVENIA	CROATIA	BOSNIA AND HERZEGOVINA	MONTENEGRO	SERBIA	GREECE
Water proprietorship	Public	Public water good	Public water good		Public water good	Public good	Public water good
Water law	Legislative Decree no. 152, of 3 April 2006, concerning "Norme in Materia Ambientale", published in "Supplemento Ordinario alla Gazzetta Ufficiale della Repubblica Italiana, n. 88 del 14 Aprile 2001" and further modifications, (Italian "Environmental Code")	Waters Act (Official Gazette of the RS No. 67/02, 2/04 – ZZdrI-A, 41/04 – ZVO-1, 57/08, 57/12, 100/13, 40/14), in Slovenian: *Zakon o vodah*	Water Act (Official Gazette of Republic of Croatia (OG). 153/09, 130/11, 56/13, 14/14, in Croatian: *Zakon o vodama*)	Water law 2006 (Official Gazette of FB&H no. 70/06); Law on water 2006 (Official Gazette RS, no. 50/06).	Water Act (Official Gazette of Republic of Montenegro No. 27/2007, 32/2011, 47/2011 in Montenegrin: Zakon o vodama)	Water Act (Official gazette of Republic of Serbia 30/2010 and 93/2012), original title: Zakon o vodama	Law3199/2003 Off.Gaz.280/9-12-2003 (in accordance with the WFD 2000/60/EC); Presidential Decree 51/2007 (Off.Gaz.54/8-3-2007) art.7; River Basin Management Plan of each Water District
Responsibility for drinking water protection	Regions (Italian administrative units) must identify safeguard zones, based on a proposal made by Local Authorities on Water Service Management (Optimal Territorial Area Government Bodies). Measures and restrictions can be enforced by Municipalities and Province administrations, by integrating them in their Urbanistic and Sectorial Plans, in order to assure the protection of surface water and groundwater intended for human consumption.	Legal act: Waters Act Resposibility: Ministry responsible for the environment prepares Decree on the water protection zone for the aquifers, which is issued by the Government of the Republic of Slovenia	From Article 91, Paragraph 3 of the Water Act: The decision on water source protection, with the prior approval of Croatian Waters, is adopted by : 1. the representative body of local government, if the zone is in the area of local government unit, 2. the representative body of regional government, if the zone extends over an area of several local governments within the same regional government, 3. consensually by representative bodies of regional governments, if the zone extends on the territory of several regional government units. Water utilities are resposible for I zone.	Legal acts: Water Law for FB&H; Law on Water for RS; Resposibility: Entity Ministries of Agriculture,Water Management and Forestry are responsible for preparation of Decrees on theWater Protection Zones for the Aquifers	Responsibility: Ministry of the Agriculture and Rural Development	Legal Act: Water Act, by - Laws Reponsible : Ministry of Agriculture and Environmental Protection; Ministry of Health; for local level Local authorities. Water Act, article 77: For local level request for PZ delineation is submitted by local authorities for specific lots. If drinking water source is located within the two or more municipalities, each municipality submit request for delineation. More details relevant to this article are provided in summary report submitted with this document.	Ministry of Reconstruction of Production, Envrionment & Energy through Special Water Secretariat. Article 7 of the PD 51/2007: Water Directorates of the Regional Authorities in agreement with the Heatlh Directorates. The Secretary General of each Regional Authority issues a decision identifying the safeguard zones and possible restrictions, prohibitions, terms for activities and uses.
Legal document for drinking water protection	Legislative Decree no. 152, of 3 April 2006, art. 94; Guidelines concerning DWPAs individuation, following the Agreement between Italian State and Regions, of 12 December 2002	Rules on criteria for the designation of a water protection zone (Official Gazette of the RS No. 64/04, 5/06, 58/11), in Slovenian: *Pravilnik o kriterijih za določitev vodovarstvenega območja*	Regulation on conditions for determining sanitary protection zones of water sources (OG 066/2011, 047/2013; in Croatian: *Pravilnik o uvjetima za utvrđivanje zona sanitarne zaštite izvorišta*)	Regulation on defining conditions for determining sanitary protection zones and protection measures for public water supply water sources (Official Gazette of FBiH, no. 88/12); Rulebook on the requirements method for defining and maintaining sanitary zones around water supply structures (Official Gazette of the RS, no. 7/03).	Regulation on methods for determining and maintaining sanitary protection zones for drinking-water sources and restrictions in the related zones, Official Gazette of MNE No. 66/2009), in Montenegrin:Pravilnik o određivanju i održavanju zona sanitarne zaštite izvorišta i ograničenjima u tim zonama)	Regulation on Establishment and management of drinking water source protection zones („Official Gazette RS", no.92/08) original title: Pravilnik o načinu određivanja i održavanja zona sanitarne zaštite izvorišta vodosnabdevanja („Službeni glasnik RS", br.92/08)	Programme of Measures, River Basin Management Plan of each Water District; Decision of the Secretary General of each Regional Authority (title: Prohibitive, restrictive and other regulatory measure for the uses and operation of water resources utilization works aiming at the protection and management of the water potential"
Expert grounds	The Guidelines issued following the Agreement between Italian State and Regions of 12 December 2002 describes 3 different criteria for DWPAs identification and delineation: a) geometric: usually adopted for the delineation of the absolute guardianship zone and the respect zone relating surface water abstraction; b) temporal: based on the concept of "safety time" (as defined in the Guidelines), it mainly applies to the final individuation and delineation of the respect zone for wells and possibly springs; c) hydrogeological: based on the specific hydrogeological elements characterizing the aquifer and its limits, it is usually applied to the protection zones concerning springs and the respect zones concerning wells, provided the particular complexity of local hydrogeological conditions does not allow the use of the temporal criterion. Perimeters established using the last two criteria (letters b) and c)) must be based on geological, hydrogeological, hydrological, hydro-chemical and microbiological studies, also taking into account historical data referred to qualitative and quantitative features of the investigated water resources. Such studies are designed to identify and define the limits of the areas influenced by water abstraction and must comply with the given technical guidelines.	An authorized institution (currently the Geological Survey of Slovenia) prepares expert's report for the implementation of Protection Zones under the auspices of the ministry responsible for the environment. Expert's report can be also prepared by other institution for Municipalities upon their initiative (not legally required) – these documents are transferred to the ministry responsible for the environment for assessment and further proceedure. Water-research works and study of sanitary protection zones is done by experts according to requirements of the Rules on criteria for the designation of a water protection zone (Official Gazette of the RS No. 64/04, 5/06, 58/11)	Water-research works and study of sanitary protection zones is done by expert firms that are authorised for that . After that the prefect (county ruler), mayor and municipal mayor in the cases referred in Article 91, Paragraph 2 of the Water Act establish the commission for preparation of a draft of decision on water sources protection. Further process of making decision on water source protection is carried out according to the regulations on the adoption of general acts of local government units and regional government units. The authority referred in Article 91, Paragraph 2 of the Water Act, within 12 months from the date of the decision on water sources protection brings the Program of recovery measures within the sanitary protection zones for existing buildings and existing activities which becomes an integral part of the decision on water sources protection.	Study of drinking water sanitary protection zones could be done by expert institutions which are authorised and equiped for such a research works. Following process of decision making on water source protection is carried out by local governments (Cantonal Governments for FBiH and Entity Government for RS) according to the aforesaid regulations on the adoption of general acts. Finished documents should be acquired and approved by the Ministries of Agriculture, Water Management and Forestry on Entity level.	Pursuant to Article 57, paragraph 5 of the Water Act the Ministry of Agriculture and Rural Development, in agreement with the Ministry of Health, Ministry of Economy and the Ministry of Sustainable Development and Tourism adopted t*he Regulation on methods for determining and maintaining sanitary protection zones for drinking-water sources and restrictions in the related zones.*	An authorized (licensed) institution is constracted by Local authorities to prepare the report – elaborate for the implementation of the Protection Zones. Surveys and studies for drinking water sources delineation and protection are done by experts in line with requirements from legal framework. According to Article 77, paragraph 3 (Water Act , Official gazette of Republic of Serbia 30/2010 and 93/2012) Ministries and Ministers responsible for water resourcesmanagement, environmental protection and public health more precisely define and propose specific requirements for dinking water source delineation with respect to capacity, protection zones, management and use within the protection zones.	The Experts who prepared the River Basin Management Plans for each Water District identified a Programme of Measures including measures for the protection of Drinking Water according to the Art. 7 of the WFD. The RBMPs are approved by the Minister and Intermediate reports are issued regarding the implementation of measures in the Water Districts.
Implementation procedure	According to article 94, Part III, of the Legislative Decree 152/2006, Regions must identify safeguard zones, on which measures and restrictions can be enforced in order to assure the protection of surface water and groundwater intended for human consumption, based on a proposal made by Local Authorities on Water Service Management (Optimal Territorial Area Government Bodies).	Implementation is the responsibility of the state. The government issues legal acts for water protection. During the preparation of expert guidelines and legal acts, protection measures are negotiated with the interested parties. Consideration of their opinions is not obligatory; however in the process all interests are considered to the maximum possible extent.	From Article 91, Paragraph 3 of the Water Act: The decision on water source protection, with the prior approval of Croatian Waters, is adopted by : 1. the representative body of local government, if the zone is in the area of local government unit, 2. the representative body of regional government, if the zone extends over an area of several local governments within the same regional government, 3. consensually by representative bodies of regional governments, if the zone extends on the territory of several regional government units.	Implementation for the teritorry of FBiH is the responsibility of the Cantonal governments for each Canton, and for teritorry of RS is the responsibility of the Entity Government (RS is not split in Cantons, it is made of several Municipalities). The aforesaid local government bodies issue legal acts for water protection. Preparation of expert guidelines and legal acts, as well as protection measures are in this kind of process negotiated with the interested parties.	Implementation is the responsibility of the state. The government issues legal acts for water protection. During the preparation of expert guidelines and legal acts, protection measures are negotiated with the interested parties. Consideration of their opinions is not obligatory; however in the process all interests are considered to the maximum possible extent.	The minister responsible for Public health, makes a decision on the determination of sanitary protection zones referred to in Water Act Art. 77, based on the study prepared in accordance with regulations.	The boundaries of the protection zones identified for drinking water abstraction are determined in the River Basin Management Plan and apply as such. The Regional Water Directorate is responsible for the implementation under the guidance of the Special Water Secretariat.
Indemnities	No legally defined indemnities.	The farmer whose income from farming is reduced because of the water protection regime (only in DWPZ I) must be provided with a replacement land plot or compensation.	No legally defined indemnities.	No legally defined indemnities.	No legally defined indemnities.	No legally defined indemnities.	No legally defined indemnities.
Protection zones	According to the Italian legislation presently in force (Legislative Decree no. 152/2006, Art. 94) safeguard zones are divided into: 1. absolute guardianship (or protection) zone: an area of at least 10 m radius, immediately surrounding the abstraction point; 2. respect zone: the territory surrounding the absolute guardianship zone, to be identified in relation to local vulnerability and hazard conditions, where specific measures and restrictions must be taken into account and some activities are strictly forbidden; 3. protection zones: wider zones identified within the groundwater recharge areas, to ensure adequate protection of water resources.	Capture zone – fenced protection zone (zone 0) Inner Zone (WPZ I) Middle Zone (WPZ II) Outer Zone (WPZ III) Based on the risk analysis, Zones II and III can be further divided.	For the purpose of determining the extent of water-research works and delineation of sources protection zones, sources are classified as: 1. sources with a maximum capacity up to 20 l/s in terms of the pumping dynamics, 2. sources with a maximum capacity from 20 l/s to 100 l/s in terms of the pumping dynamics and 3. sources with a maximum capacity greater than 100 l/s in terms of the pumping dynamics. Sanitary protection zones are determined according to the aquifer type for: 1. sources with abstraction from groundwater: - from aquifer with intergranular porosity (I zone, II zone, III zone), - from aquifer with fracture and fracture-cavernous porosity (I zone, II zone, III zone, IV zone); 2. sources with abstraction of surface water: - from reservoirs and lakes (I zone, II zone, III zone), - from open watercourses (I zone). For a more detailed explanation see sheet/Table CROATIA - Protection zones.	(1) For the protection of sources under Article 4 paragraph a) and b), relevant Rulebook for FB&H establishes the minimum requirements for the I, II and III protection zones for water sources under Article 4 paragraph c) and d). Mentioned Article establishes at least I and II Protection Zone referred to in paragraph 2 of same article. (2) Subject to the provisions of the regulations for the protection of water sources are determined by four protection zones, as follows: a) I protection Zone as the zone with the strictest prohibitions and restrictions; b) II protection Zone as a zone with strict prohibitions and restrictions; c) III protection zone as a zone of moderate prohibitions and restriction; d) IV protection zone as the zone with preventive prohibition and restriction.	Capture zones: WPZ I - strict zone protection; WPZ II - restricted zone protection; WPZ III - surveillance zone (wider zone protection)	Inner Zone (DWS PZ I) Middle Zone (DWS WPZ II) Outer Zone (DWS WPZ III) Generally speaking, the establishment of 3 protection zones (I, II and II) drinking water sources are delineated based on different criteria (travel time, hydrology, hydrogeology, etc).This is a widely used criterion that should provide confidence that the concentration of contaminants will have been reduced to an acceptable level. Information and data on protection zones should be included and properly marked in different planning documents (water management plans, spatial plans) at different level, e.g., local, regional	Delineation of protection zones in surface water resources: 1. Zone I (strict protection or prohibition); 2. Zone II (nearby protection or controlled zone); and 3. Zone III (distance or surveillance zone). Delineation of protection zones in groundwater resources (boreholes, springs, wells): 1. Zone I (strict protection); 2. Zone II depending on the aquifer: - karstic aquifer; - granular systems of free flow; - granular systems under pressure or partially under pressure; - fracture systems. 3. Zone III.
Criteria for protection zones definition	Guidelines issued following the Agreement between Italian State and Regions of 12 December 2002 describes 3 different criteria for DWPAs identification and delineation: (geometric, hydrogeological, temporal), also giving technical elements and specific methodologies for each kind of water source (wells, springs, surface water).	Geological conditions (e.g. karstification) in the recharge area. Travel times are defined for potential pollutants.	It is too complex to be written in this table, see sheet/Table CROATIA - Protection zones.	Geological conditions (karstification, springs with infiltration of surface waters) in the aquifers.	Criterias: Type of sources and its capacities. For a more detailed explanation see sheet/Table Montenegro - Protection zones.	Please refer to sheet/Table Serbia - Protection zones in this document.	The location, the boundaries and the size of the safeguard zones depend on the hydrogeological, hydrodynamic and hydro chemical conditions of the zone of water intake, the land uses and the vulnerability of the aquifer

Workpackage 4

Activity 4.4 Water (re)sources protection and cross border water (re)sources management

Drinking Water Protection Zones

ANNEX 3

Overview of drinking water protection measure for surface water in IPA region from countries involved in the project

Country: Italy

Surface drinking water resources protection

Questionnaire

1 What is the share of drinking water supply for surface water body on the state level?

		mark the interval of the estimate
	%	15%
	0%	
	<10%	
X	10% - 30%	
	30% - 60%	
	60% - 90%	
	>90%	
	100%	
	not known	

Source: ISTAT (2012)

2 Water is captured from

		mark the type of water resources (several marks are possible)
X	natural lakes	
X	artificial reservoirs	
X	flowing water	
	not known	
X	others	

Source: ISTAT (2012)

2.1. If water is captured from flowing water bodies, in which order of magnitudes is discharge of these streams (if possible define the number or share in water supply they are contributing)

		mark the interval of the estimate (msot frequent capacity)
	<10 l/s	
	10-100 l/s	
	100 - 1000 l/s	
	> 1000 l/s	
	other	

Not known

3 Are there exist water resorces which can be defined as mixed?

		mark the answer
X	yes	
	no	
	other	

4 Are there systems where artificial recharge is present? (based on infiltration facilities)?

		mark the answer
X	yes	
	no	
	other	

Experimental stage

5 Are there particular water resources for which drinking water protection zones are defined by the special legally definied act?

		mark the answer
	yes	
	no	
	other	

Not known

6 Are drinking protection zones on surface water bodies defined based on the elaborated study prepared with the expert?

		mark the answer
X	yes	
	no	
	other	

6.1. If study is prepared, please briefly describe the content of the study.

Example (Castreccioni Lake): 1. Historical research and evaluation of the main technical features of the specific artificial reservoir and abstraction facility; 2. Assessment of Geological and Geomorphological characteristics of the Study Area; 3. Hydrogeology of the Study Area (surface water/groundwater contributions); 4. Water Balance, evaluation of direction and quantitative contribution of groundwater inflow, to be compared with annual discharge (dam outlet); 5. Evaluation of Water Resource Vulnerability and delineation of protection zones.

7 What are guidelines and baselines for the criteria on which protection criteria are defined in the legislation?

		mark the answer
	administrative	
	theoretical	
X	combination of both	
	other	

7.1. If above is answered that guidelines are based on the theory, please briefly describe what type of the theory was applied.

The Guidelines issued following the Agreement between Italian State and Regions of 12 December 2002 describes specific criteria for DWPAs identification and delineation. Within the respect zone, specific, listed activities/hazard centers are forbidden, also taking into account theoretical baselines (e.g. Nitrogen in livestock effluents). Please refer to the Table concerning Protection Zones Legislation in Italy for further details.

7.2. If above is answered that guidelines are based on the administrative measures please briefly describe what are administrative starting points.

Specific measures and restrictions concerning soil destination of use can be implemented by Municipalities and/or Regional or Province administrations, by integrating them in the general urbanistic and specific sectorial plans, in order to assure the protection of surface water and groundwater intended for human consumption. Please refer to the Table concerning Protection Zones Legislation in Italy for further details.

2	marine and brakish water (less than 0,1%)
2.1	
3	
4	
5	
6	
7	

Country: Croatia

Surface drinking water resources protection

Questionnaire

1 What is the share of drinking water supply for surface water body on the state level?

	%	(if known exactly)
	0%	
10%	<10%	mark the interval of the estimate
	10% - 30%	
	30% - 60%	
	60% - 90%	
	>90%	
	100%	
	not known	

2 Water is captured from

natural lakes	natural lakes	mark the type of water resources (several marks are possible)
artificial reservoirs	artificial reservoirs	
flowing water	flowing water	
	not known	
	others	

2.1. If water is captured from flowing water bodies, in which order of magnitudes is discharge of these streams (if possible define the number or share in water supply they are contributing)

	<10 l/s	mark the interval of the estimate (msot frequent capacity)
	10-100 l/s	
	100 - 1000 l/s	
> 1000 l/s	> 1000 l/s	
	other	

3 Are there exist water resorces which can be defined as mixed?

	yes	mark the answer
no	no	
	other	

4 Are there systems where artificial recharge is present? (based on infiltration facilities)?

	yes	mark the answer
no	no	
	other	

5 Are there particular water resources for which drinking water protection zones are defined by the special legally definied act?

	yes	mark the answer
no	no	
	other	

6 Are drinking protection zones on surface water bodies defined based on the elaborated study prepared with the expert?

yes	yes	mark the answer
	no	
	other	

6.1. If study is prepared, please briefly describe the content of the study.

zones, hydrogeological characteristics, water quality, cadastre of pollutants, proposal of protection measures, including locations of intake of corresponding zones, proposal of remediation measures on existing objects if necessary and proposal for work regime.

7 What are guidelines and baselines for the criteria on which protection criteria are defined in the legislation?

	administrative	mark the answer
	theoretical	
combination of both	combination of both	
	other	

7.1. If above is answered that guidelines are based on the theory, please briefly describe what type of the theory was applied.

7.2. If above is answered that guidelines are based on the administrative measures please briefly describe what are administrative starting points.

The Water Act (OG 153/09,130/11, 53/13, 14/14) regulates and defines the legal status of water and water estate, the preconditions for their use and protection, and the activities and organization of water management. Rules for the establishment of sanitary protection zones (OG 66/2011, 47/2013) regulates protection.

2	
2.1	
3	
4	
5	
6	
7	Sanitary protection zones for sources with abstraction from surface waters Sanitary protection zones for sources with abstraction of water from reservoirs and lakes Sanitary protection zones for reservoirs and lakes are: - zone of restriction and surveillance - III zone, - zone of strict restriction and surveillance - II zone and - zone of strict protection regime and surveillance – I zone. III sanitary protection zone for reservoirs and lakes is determined to protect the reservoir or lake from the impact from surfaces in the watershed of reservoir or lake. III sanitary protection zone of reservoirs and lakes is determined only for reservoirs and lakes to which water flows only from land surface, and not from watercourses or torrents. III sanitary protection zone for reservoirs and lakes includes the zone from the border of II zone to the outer border of reservoir or lake watershed. In III sanitary protection zone for reservoirs and lakes is forbidden: - waste storage and disposal, construction of landfill except for the sanation remediation of existing one for the purpose of its closure, buildings for waste management including waste incinerators, regional and county waste management centers, recycling yards and waste reloading stations if there is not planned the implementation of water protection measures and facilities for treatment, recovery and disposal of hazardous waste, - discharge of untreated wastewater, - storage of petroleum and petroleum products, - construction of facilities for storage, transport, handling, treatment and disposal of radioactive and other substances hazardous for water, - construction of roads without drainage structures and devices for collecting oil and fats and treatment of polluted rainwater, - exploitation of gravel, sand, stone and clay, - construction of industrial plants without systems for wastewater collection and treatment, - construction of pipelines for fluids that can cause water pollution. In agricultural production, including livestock production, agricultural economies (farms) are obliged to provide conditions and implement measures referred in Article 1, paragraph 3 of this Regulation. II sanitary protection zone for reservoirs and lakes is determined to protect the reservoir or lake from pollution brought by permanent or temporary water inflows. II sanitary protection zone for reservoirs and lakes includes zone which is wide at least 100 m on each side of the inflow, measured from the outer border of I zone, and extends along the inflow to the border of reservoir or lake sub-basin, and the area of 100 m along the reservoir or lake measured from the outer border of I zone. In II sanitary protection zone for reservoirs and lakes are applied prohibitions from III zone, and also is forbidden: - agricultural production, except organic production with the use of permitted fertilizers and plant protection products according to a special regulation, - livestock productionbreeding, except farms up to 20 livestock units with implementation of water protection measures prescribed with appropriate program for the protection of waters against pollution caused by nitrates of agricultural origin and principles of good agricultural practices, - construction of cemeteries and their extension, - construction of other buildings that may endanger the quality of water in reservoirs and lakes. I sanitary protection zone for reservoirs and lakes is determined to protect reservoirs and lakes and water-intakes from any damage, pollution and contamination, and other accidental or deliberate adverse effects. I sanitary protection zone for reservoirs and lakes includes the reservoir ie. lake, dam, water intake structure, pumping station, water conditioning plant, building for protection of the source, protective settling tanks at the confluence of the inflow and protective zone along the reservoir or lake 10 m wide from the water's edge at the highest water level. In the I sanitary protection zone for reservoirs and lakes have to be fenced: water intake structure, pumping stations, water conditioning plants and buildings for protection of the source. In the I sanitary protection zone for reservoirs and lakes are applied prohibitions from II zone, and also is forbidden: - performance of works, construction and performing economic and other activities except for those which are necessary for abstraction, treatment and transport of water into the water supply system, - use of fertilizers and plant protection products, - discharge of waste water from operating buildings and water for washing the drinking water conditioning plant, - use of all boat types, water sports and swimming, - fishing, sport fishing and fish farming, - keeping and watering livestock keeping and watering and - public transport of vehicles and pedestrians. Sanitary protection zones for sources with abstraction of water from open watercourses For abstraction of water from open watercourse only I sanitary protection zone is determined. I sanitary protection zone for open watercourse includes the area of direct water intake, river bed and river bank along the intake, pumping stations, drinking water treatment plant, structures for protection of water source, and the opposite bank in width of 10 m from the edge of river bed if the river bed is narrower than 20 m at low waters. Boundary of I sanitary protection zone of open watercourse in the watercourse must be at least 10 m away from the water intake structure in all directions, and it is marked by buoys. In the I sanitary protection zone of open watercourse the boundary, in relation to the structures at the bank above the level of high water, must be at least 10 m away in all directions from the following structures: water intake, pumping station, water conditioning plant, structures for protection of water source and it must be enclosed with a stable fence. In the I sanitary protection zone for open watercourse is forbidden: - performance of works, construction and performing economic and other activities except for those which are necessary for abstraction, treatment and transport of water into the water supply system, - discharge of waste water from operating buildings and water for washing the drinking water conditioning plant, - use of fertilizers and plant protection products, - use of all boat types, anchoring, water sports and swimming, - fishing and sport fishing, - keeping and watering livestock keeping and watering, - public transport of vehicles and pedestrians, - deepening of the river bed and - exploitation of gravel, sand, stone and clay.

Country: Serbia

Surface drinking water resources protection

Questionnaire

1 What is the share of drinking water supply for surface water body on the state level?

	%	Very close to 30%
	0%	
	<10%	mark the interval of the estimate
	10% - 30%	
	30% - 60%	
	60% - 90%	
	>90%	
	100%	
	not known	

2 Water is captured from

	natural lakes	mark the type of water resources (several marks are possible)
25%	artificial reservoirs	
75%	flowing water	
	not known	
	others	

2.1. If water is captured from flowing water bodies, in which order of magnitudes is discharge of these streams (if possible define the number or share in water supply they are contributing)

2%	<10 l/s	mark the interval of the estimate (msot frequent capacity)
8%	10-100 l/s	
20%	100 - 1000 l/s	
70%	> 1000 l/s	
	other	

3 Are there exist water resorces which can be defined as mixed?

	yes	mark the answer
	no	
	other	

4 Are there systems where artificial recharge is present? (based on infiltration facilities)?

	yes	mark the answer
	no	
	other	

5 Are there particular water resources for which drinking water protection zones are defined by the special legally definied act?

	yes	mark the answer
	no	
	other	

6 Are drinking protection zones on surface water bodies defined based on the elaborated study prepared with the expert?

	yes	mark the answer
	no	
	other	

6.1. If study is prepared, please briefly describe the content of the study.

It's generally defined by law, and content should be as followed:
Elaborat o zonama sanitarne zaštite izvorišta sadrži sledeće celine:
1) projektni zadatak u odnosu na namenu izvorišta;
2) podatke o geografskim, topografskim, morfološkim, geološkim, hidrogeološkim, hidrološkim, hidrodinamičkim i drugim karakteristikama sliva i izvorišta;

7 What are guidelines and baselines for the criteria on which protection criteria are defined in the legislation?

	administrative	mark the answer
	theoretical	
	combination of both	
	other	

7.1. If above is answered that guidelines are based on the theory, please briefly describe what type of the theory was applied.

Three protection zones for all types of sources:
1. Direct zone (For Lakes: 10m from lakes and his tributaries; For Rivers: upstream 100m, downstream 20m, lateral 30m)
2. Primarry protection zone (For Lakes: from direct zone 500m)
3. Wide protection zone (For Lakes: from zone 2 (primarry) to all catchment area)
For grounwater is of course different, but I have understood that the question and whole questionnaire is related to surface water

7.2. If above is answered that guidelines are based on the administrative measures please briefly describe what are administrative starting points.

Remark is given in Question 7.

2	From the consumption of surface water
2.1	From the total amount of drinking water consumption from surface water sources
3	We are not sure what do you mean with "mixed water sources". If you mean combined surface and groundwater, one source could not be the both in the same time. We have some sources which are combined alluvial and fissured rock, but the both are groundwater. Serbia have also artificial groundwater source which take surface water for recharge it.
4	As stated in the previous answer Serbia has artificial grounwater source which take surface water for recharge it.
5	First, it's not "specially", it is just legal act. It is defined depend on the type of the source: 1. Grounwater 1a. Alluvial sourc 1b. Karst 1c. Deep water body 2. Lakes (generally artificial, we have just a few natural lakes) 3. Rivers
6	
7	

Country: Bosia and Herzegovina

Surface drinking water resources protection

Questionnaire

1 What is the share of drinking water supply for surface water body on the state level?

	%	(if known exactly)
	0%	
	<10%	
✓	10% - 30%	mark the interval of the estimate
	30% - 60%	
	60% - 90%	
	>90%	
	100%	
	not known	

2 Water is captured from

✓	natural lakes	mark the type of water resources (several marks are possible)
✓	artificial reservoirs	
✓	flowing water	
	not known	
	others	

2.1. If water is captured from flowing water bodies, in which order of magnitudes is discharge of these streams (if possible define the number or share in water supply they are contributing)

	<10 l/s	mark the interval of the estimate (most frequent capacity)	Watercourses used for drinking water abstraction in BiH have different capacities. Minimum capacity for some streams amounts to > 100 l/s, while the capacity of above 15.000 l/s is typical for some rivers such as Una, Sana, Vrbas and Pliva.
	10-100 l/s		
✓	100 - 1000 l/s		
	> 1000 l/s		
	other		

3 Are there exist water resorces which can be defined as mixed?

✓	yes	mark the answer	Mixed water sources could also include springs where groundwater aquifer is artificially recharged with surface water.
	no		
	other		

4 Are there systems where artificial recharge is present? (based on infiltration facilities)?

✓	yes	mark the answer	Please see the next sheet.
	no		
	other		

5 Are there particular water resources for which drinking water protection zones are defined by the special legally definied act?

	yes	mark the answer	Unknown.
	no		
✓	other		

6 Are drinking protection zones on surface water bodies defined based on the elaborated study prepared with the expert?

✓	yes	mark the answer	According to the existing Law and Rulebook, all water protection zones identified for all types of water sources in BiH are primarily identified on the basis of a study prepared by experts.
	no		
	other		

6.1. If study is prepared, please briefly describe the content of the study.

Please see the next sheet.

7 What are guidelines and baselines for the criteria on which protection criteria are defined in the legislation?

	administrative	mark the answer
✓	theoretical	
	combination of both	
	other	

7.1. If above is answered that guidelines are based on the theory, please briefly describe what type of the theory was applied.

This basically refers to hydrological and hydraulic parameters, as well as particular water quality parameters, i.e. criteria used after the identification of the existing basin state by applying theoretical calculations about quantities and velocities of water discharge to the intake. Furthermore, different calculations of suspended matter production and discharge – intake estimate are also applied. Regarding quality parameters, laboratory testing is applied.

7.2. If above is answered that guidelines are based on the administrative measures please briefly describe what are administrative starting points.

2	
2.1	
3	
4	There are several sources in BiH with artificial recharge, such as Sarajevsko Polje (Sarajevo Valley) used for water supply of Sarajevo. Moreover, water source used for the supply of Banja Luka is also artificially recharged with the water from the Vrbas River. For this purpose, structures for the artificial infiltration of surface water into ground were constructed. In addition to the above-mentioned large water supply systems in BiH where structures for artificial recharge were constructed, such structures can also be found in smaller water supply systems used for the supply of smaller cities, such as Maglaj and Tešanj, as well as sparsely inhabited town of Usora.
5	
6	Study about drinking water sources protection is prepared by the competent experts comprising a team of experts formed for every water source which requires a study. When forming a team of experts, it is important to ensure the presence of all experts from the fields related to the issue of drinking water sources. Structure of the study is prescribed by the existing Rulebook, though the study may differ for different sources, depending on the specific problem to be solved. However, according to the Rulebook, the study should include at least the following: 1. Terms of Reference verified by the client. 2. Certified copy of land register record for the water source protection zone I. 3. General characteristics of the water source basin. 4. Geological and hydrogeological characteristics of the water source basin with spatial model prepared and the evaluation of sensitivity index for geological and hydrogeological structures in relation to the existing and planned activities in the water source basin. 5. Hydrological characteristics of the water source basin. 6. Vegetation characteristics of the water source basin. 7. Characteristics of erosion processes in the basin. 8. Quantity and quality characteristics of water at the source. 9. If it involved the issue of groundwater – optimal well capacity, aquifer porosity, coefficient of filtration and transmission, real groundwater velocities, specific groundwater levels, designed groundwater level reduction, as well as dynamic water level in the well identified during well testing process. 10. Cadastre of existing and potential pollution sources. 11. Summary of the results of possible additional investigations. 12. Summary of the main water supply system characteristics (population number, required water quantity, regime of the system etc.). 13. Technical analysis and identification of the key hydrodynamic and hydrogeological characteristics of the water source basin, including calculation of pollution risk index in order to identify types and sizes of protection zones and define the area of particular protection zones. 14. Identification of existing activities in particular water protection zones and their specification according to the article 10 points 1 – 6 of the Rulebook. 15. Identification of protection measures for particular water protection zones. 16. If needed, proposal for the rehabilitation of the existing structures located within water protection zones. 17. Monitoring plan for water quality at the source. 18. Cost estimate for the implementation of the Protection Decision. 19. Conclusion about technical and financial justification for the implementation of water source protection in relation to the potential alternative solutions. 20. Preliminary draft of the Water Source Protection Decision. 21. Layouts of water protection zones on the maps of adequate ratio, where layouts of water source protection zone I should present all intake structures. All data presented in the study have to be processed in GIS software and its databases have to be consolidated with the format of Water Information System (WIS) created by the relevant water agencies after the issuance of the Decision on Water Sources Protection.
7	

Country: Montenegro

Surface drinking water resources protection

Questionnaire

1 What is the share of drinking water supply for surface water body on the state level?

	%	(if known exactly)	
	0%	mark the interval of the estimate	
	<10%		
	10% - 30%		
	30% - 60%		
	60% - 90%		
	>90%		
	100%		
	not known		

2 Water is captured from

	natural lakes	mark the type of water resources (several marks are possible)	
	artificial reservoirs		
	flowing water		
	not known		
	others		

2.1. If water is captured from flowing water bodies, in which order of magnitudes is discharge of these streams (if possible define the number or share in water supply they are contributing)

	<10 l/s	mark the interval of the estimate (most frequent capacity)	
	10-100 l/s		
	100 - 1000 l/s		
	> 1000 l/s		
	other		

3 Are there exist water resorces which can be defined as mixed?

	yes	mark the answer	
	no		
	other		

4 Are there systems where artificial recharge is present? (based on infiltration facilities)?

	yes	mark the answer	
	no		
	other		

5 Are there particular water resources for which drinking water protection zones are defined by the special legally definied act?

	yes	mark the answer	
	no		
	other		

6 Are drinking protection zones on surface water bodies defined based on the elaborated study prepared with the expert?

	yes	mark the answer	
	no		
	other		

6.1. If study is prepared, please briefly describe the content of the study.

Each municipality makes studies that are in accordance with legal regulations

7 What are guidelines and baselines for the criteria on which protection criteria are defined in the legislation?

	administrative	mark the answer	
	theoretical		
	combination of both		
	other		

7.1. If above is answered that guidelines are based on the theory, please briefly describe what type of the theory was applied.

7.2. If above is answered that guidelines are based on the administrative measures please briefly describe what are administrative starting points.

Country: Greece

Surface drinking water resources protection

Questionnaire

1 What is the share of drinking water supply for surface water body on the state level?

	%	(if known exactly)	
	0%	mark the interval of the estimate	
	<10%		
X	10% - 30%		
	30% - 60%		
	60% - 90%		
	>90%		
	100%		
	not known		the estimated value (2012) is 12%

2 Water is captured from

X	natural lakes	mark the type of water resources (several marks are possible)	
X	artificial reservoirs		
	flowing water		
	not known		
X	others		springs, groudwater/aquifers, desalination plants

2.1. If water is captured from flowing water bodies, in which order of magnitudes is discharge of these streams (if possible define the number or share in water supply they are contributing)

	<10 l/s	mark the interval of the estimate (msot frequent capacity)	
	10-100 l/s		
	100 - 1000 l/s		
	> 1000 l/s		
	other		

3 Are there exist water resources which can be defined as mixed?

X	yes	mark the answer	
	no		
	other		

4 Are there systems where artificial recharge is present? (based on infiltration facilities)?

X	yes	mark the answer	
	no		
	other		

5 Are there particular water resources for which drinking water protection zones are defined by the special legally definied act?

	yes	mark the answer	
X	no		
	other		

6 Are drinking protection zones on surface water bodies defined based on the elaborated study prepared with the expert?

	yes	mark the answer	
	no		
X	other		

6.1. If study is prepared, please briefly describe the content of the study.

7 What are guidelines and baselines for the criteria on which protection criteria are defined in the legislation?

	administrative	mark the answer	
	theoretical		
	combination of both		
X	other		

7.1. If above is answered that guidelines are based on the theory, please briefly describe what type of the theory was applied.

7.2. If above is answered that guidelines are based on the administrative measures please briefly describe what are administrative starting points.

2	Springs, groudwater/aquifers, desalination plants.
2.1	
3	
4	
5	
6	The drinking water protection zones on surface water are not defined yet by any legislative document. Related studies will be elaborated in the context of the River Basin Management Plans and the Programmes of Measures.
7	The drinking water protection zones on surface water are not defined yet by any legislative document

Workpackage 4

Activity 4.4 Water (re)sources protection and cross border water (re)sources management

Drinking Water Protection Zones

ANNEX 4

Questionnaires for "Procedures of drinking water protection zones (DWPZ) implementation" from countries involved in the project:

Italy
Slovenia
Croatia
Serbia
Albania
Bosnia and Herzegovina
Greece

Country: Italy

QUESTIONNAIRE by DMG-UNITS pro Project Leader
Procedures of drinking water protection zones (DWPZ) implementation

This questionnaire is intended to improve the knowledge of procedures of drinking water protection zones (DWPZ) implementation. It follows out from the already received data and performed analyses as well as discussion in Trieste.

I. **DPWZ are designed based on the field investigations and desk studies. How DPWZ are transferred to the space and how DPWZ are considered in the spatial planning procedures?** In Italy, the Legislative Decree no. 152/2006 entrusts to the competent Regions the responsibility of the development of guidelines and regulations that are necessary to define the protection areas. Presently, no one region has yet defined the protection zones (*Zona di Rispetto* – Safeguard Zone – Zone 2 and *Zona di Protezione* – Protection Zone – Zone 3).
I.1 Who are parties with whom DPWZ are discussed (e.g.)? The Water Protection Plans are developed by the competent Regions and then discussed with all the stakeholders (local communities, water managers, land owners, any other interested party)
I.2 Are borders of DWPZ negotiated and agreed? Borders of Wellhead Protection Zone (*Zona di Tutela Assoluta*, D. Lgs. 152/2006) are not negotiable. They are delimited by the captation Managing Authority. The other two borders (Inner Protection Zone – *Zona di tutela* and Outer Protection Zone – *Zona di protezione*) should be established by the competent Region, but there are still no examples of their application according to the D. Lgs. 152/2006 in Italy.
I.3 Are interdictions, limitations and measures negotiated? In the Wellhead Protection Zone (*Zona di Tutela Assoluta*) the entrance for non-experts is prohibited. Only expert technicians of the Managing Authority can access them.
I.4 Are there any coordinations during this process? The protection zones should be defined by means of the agreement between the Managing Authority, experts and regional officials. There are still no examples of the application of D. Lgs. 152/2006 in Italy.
I.5 In what extend opinions from the possible procedure must be accepted and how they are accepted? There are still no examples of the application of D. Lgs. 152/2006 in Italy. The responsibility does not fall on managers but on Regions, that in this regard have

specific authority from the national government.
II. **How DWPZ borders are considered in the space and in the spatial planning process?** Seen that they do not exist, only the Wellhead Protection Zone are defined, they are not taken into account while approaching the future spatial planning.
II.1 Are borders of DWPZ drawn so that they are following land plot (cadastral / parcel) borders? The Wellhead Protection Zone are mapped on a cadastral base (scale 1: 2,000). The other zones will be almost certainly drawn on the scale of Regional Technical Numerical Map (scale 1: 5,000). However, there are still no examples of the application of D. Lgs. 152/2006 in Italy concerning the outline of the protection areas.
II.2 Are borders of DWP drawn so that only design criteria are considered, no matter what are the ownership relationships in space? As the areas will be almost certainly mapped on the scale of Regional Technical Numerical Map (scale 1: 5,000), they will be adapted to each specific local situation. There are still no examples of the application of D. Lgs. 152/2006 in Italy concerning the protection areas.
II.3 Is the list of plots (cadastral parcels) positioned on the DWPZ prepared and it is publicly available or even published in the official documents? The cadastral data that are stored in the municipalities are free.
III. **Who and how is exercising control over the surface of DWPZ?** The competent Region.
IV. **How the breaches of the requirements defined on DWPZ are penalized?** Such regulations do not yet exist.

Country: Slovenia

QUESTIONNAIRE
Procedures of drinking water protection zones (DWPZ) implementation

This questionnaire is intended to improve the knowledge of procedures of drinking water protection zones (DWPZ) implementation. It follows out from the already received data and performed analyses as well as discussion in Trieste.

I. **DPWZ are designed based on the field investigations and desk studies. How DPWZ are transferred to the space and how DPWZ are considered in the spatial planning procedures?**
I.1 Who are parties with whom DPWZ are discussed (e.g. local communities, water managers, land owners, any other party)? DWPZ are prepared by authorized expert and forwarded to the Ministry for Spatial Planning and Environment who starts the procedure. Local communities are acquainted with the design of DWPZ and their administration is asked for comments. Local administration consults water managers in public enterprises and land owners. The reason for this procedure which according to legislation is not obligatory is mainly in strong political role of local municipalities and communities.
I.2 Are borders of DWPZ negotiated and agreed? Borders of DWPZ are defined based on the applicable rules. In the next step they are presented in the maps (scale 1:5000 or 1:25000 – depending on their extent) and represented to the municipalities where the zones are positioned. Municipal administrations are usually preparing comments and objections to the design of DWPZ which are then negotiated in the several steps.
I.3 Are interdictions, limitations and measures negotiated? Sometimes in relation to the water supply plans of local municipalities they are slightly modified. However, there are no deviations from the rules where water resource can be endangered.
I.4 Are there any coordination during this process? Usually several coordination meetings with municipal authorities are taking place during the implementation procedure of DWPZ. If several municipalities are involved such process can be relatively long (several years).
I.5 In what extend opinions from the possible procedure must be accepted and how they are accepted? At the end of the negotiating process it is sole responsibility of Ministry for Spatial Planning and Environment to decide which suggestions and comments received from local authorities

will be implemented. Due to the strong political role of local communities (e.g. mayors lobby) negotiations are usually time consuming and ministry is trying to reach an agreement.

II.
How DWPZ borders are considered in the space and in the spatial planning process?

II.1
Are borders of DWPZ drawn so that they are following land plot (cadastral / parcel) borders?

DWPZ are drawn in to steps. In first step so called professional borders are defined, they are drawn only on the design criteria. In the second step land plots borders are considered. These procedures have changed in recent years. Before plots inside of DWPZ were exactly defined and sometimes even divided with the geodetic survey, nowadays where plots are to large to be divided they remain as such and they are only listed in the implementation act of DWPZ.

II.2
Are borders of DWP drawn so that only design criteria are considered, no matter what are the ownership relationships in space?

Recently ownership relations are no more considered. Detailed design of DWPZ is available at the public disposal through the internet web application and situation can be checked in any time.

II.3
Is the list of plots (cadastral parcels) positioned on the DWPZ prepared and it is publicly available or even published in the official documents?

List of plots is published, in the past the list was published in the official gazette, nowadays information are available through the web application.

III.
Who and how is exercising control over the surface of DWPZ?

Control over DWPZ is exercised in two steps. First step is implemented by water authority, when anomalies in practice are detected they are trying to remove the problem with the negotiation of land owner or they implement some sanitation or rehabilitation measure. If they are not successful than second step is implemented where Inspectorate of the environment at the state level is involved usually through various level of inspection decisions.

IV.
How the breaches of the requirements defined on DWPZ are penalized?

Breaches and penalties are defined in the Environmental Law. There are two levels of penalization. At first level the penalty is imposed by environmental inspectorate and at the second level by the competent court.

Country: Croatia

QUESTIONNAIRE
Procedures of drinking water protection zones (DWPZ) implementation

This questionnaire is intended to improve the knowledge of procedures of drinking water protection zones (DWPZ) implementation. It follows out from the already received data and performed analyses as well as discussion in Trieste.

I.
DPWZ are designed based on the field investigations and desk studies. How DPWZ are transferred to the space and how DPWZ are considered in the spatial planning procedures?

I.1
Who are parties with whom DPWZ are discussed (e.g. local communities, water managers, land owners, any other party)?

Protecting water sources and surface water intake by DPWZ is carried out in accordance with the Decision on source protection. The Decision prescribes, on the basis of the water research works, the size and borders of DPWZ, sanitary and other conditions of maintenance, protection measures, sources and methods of financing the implementation of protection measures, restrictions or prohibitions to engage in agriculture and other activities, restrictions or construction bans or performing other actions that may affect the quality or quantity of water sources and surface water intake and penalty provisions.

The Decision on source protection, with the prior approval of the Croatian Waters, is adopted by the representative body of the local government if the zone is in the area of the local self-government unit, the representative body of the regional self-government, at the proposal of the local government, if the zone covers an area of more local self-government units within the same regional unit, or by agreement of the representative bodies of regional governments, on the proposal of the local government, if they are located in the territory of several regional-governement units.

The process of drafting the Decision shall be carried out in such a way that the President of the Region, Mayor or Head of Municipality sets up a Commission to prepare a draft decision on source protection. The Commission consists of several representatives of decision makers, members of the ministry responsible for water management, the county administrative body responsible for regional planning and environmental protection, the county administrative body responsible for the economy, the county administrative body in charge of agriculture, Croatian waters and water suppliers by proposal of the body or legal person which they represent.

When Croatian Waters order water research works, they establish a commission to prepare a draft decision on the protection of water sources. The commission is then, in addition to the representatives of Croatian Waters, composed of members from the aforementioned public authorities and local governments and water suppliers, everyone by the proposal of the bodies or legal persons which they represent.

I.2
Are borders of DWPZ negotiated and agreed?

Yes, but only in the procedure of drafting the Decision through the work of the Expert Commission, and subsequently during the deliberation of the representative body which ultimately adopts the Decision. So, there is no prescribed procedure of consulting and informing the general public.

The size and borders of DWPZ are defined by the Decision on source protection adopted by the representative body of the local or regional governments with the prior consent of the Croatian Waters. It is important to emphasize that the draft Decision and the process of creating and defining all mandatory elements of the Decision are made in a multidisciplinary and multi-sectoral partnership approach, i.e. through the work of the appointed Expert Commission composed of appointed representatives of a large number of public authorities**.** When the final draft Decision is prepared, the executive body proposes the Decision to the representative body which considers and ultimately adopts the Decision.

In accordance with the Croatian legislation, when creating the Strategy of Water Management and the Water Area Management Plan a procedure of consulting and informing the general public must be carried out. **On the other hand, the Decision on DWPZ does not have to be adopted with a prior involvment of the general public.**

I.3
Are interdictions, limitations and measures negotiated?

Yes. Interdictions, limitations and measures are an integral part of the Decision on sanitary protection zones which is created in a multi-disciplinary and multi-sectoral partnership approach, i.e. through the work of the appointed Expert Commission.

I.4
Are there any coordinations during this process?

Coordinating and monitoring the development and adoption of the Decision is done by the secretariat of the Expert Commission, which usually means a person from the body of decision-makers (county, city or Croatian Waters).

I.5
In what extend opinions from the possible procedure must be accepted and how they are accepted?

As far as the proposed borders are concerned, they are proposed through a study of protection zones which precedes the process of creating the Decision on sanitary protection zones (The Decision on source protection). Borders must be proposed on the basis of expert proposals set out in the conducted water research works. After preparing the study, the institution (municipality, city or county) has to request a binding opinion of the Croatian Waters. Upon receiving the request, the Croatian Waters among their employees appoint a body for evaluating the received request and adopt a decision within 30 days. Within the described process,

special requests may be accepted. Such requests have to be endorsed by expert studies or submitted by the relevant institutions (e.g. a water supply company managing the area). In the end, the defined borders represent a cartographic review of sanitary protection zones as an essential part of the future Decision on sanitary protection zones.

II.
How DWPZ borders are considered in the space and in the spatial planning process?

II.1
Are borders of DWPZ drawn so that they are following land plot (cadastral / parcel) borders?

Not necessarily for every DWPZ. The basic graphical representations with all necessary data for the IV. and III. sanitary protection zone are at a scale of 1:25.000, for the II. sanitary protection zone in the scale of 1:5.000, and for the first zone of sanitary protection in the scale of 1:1.000. The borders of the first DWPZ for all sources, according to the Regulation on the conditions for the establishment of sanitary protection zones (Official Gazette 66/2011, 47/2013) must be aligned with the cadastral plot and in accordance with the actual situation on the field (particle property or possessory, i.e. fencing the water intake). **The borders of the second zone are aligned with the cadastral parcels only if that's done / proposed by the executed water research works.** All the other borders are not aligned with the cadastral parcels. Within the DRINKADRIA project the Region of Istria created a proposal of all currently valid DWPZ harmonized with the cadastral plot. However, given that for the most part of DWPZ necessary water research works were not carried out, these borders will not be proposed as part of an official request for updating the borders.

II.2
Are borders of DWP drawn so that only design criteria are considered, no matter what are the ownership relationships in space?

Yes. The ownership of individual parcels or objects is not taken into account. The borders always need to be proposed through water research works and after that, through a study of DWPZ submitted to Croatian Waters.
However, the overall impact of human activities is taken into account, although other features are more significant and are considered as basic criteria: geologic features and hydrogeological relations between inflow areas, hydrological features of the inflow area, size, borders and yield of the aquifer, type of aquifer due to the porosity (intergranular, cracking and fracture - cavernous), thickness and permeability of covering layers of the aquifer, the aquifer feed mode, the way water flows into the reservoir or lake, the rate of groundwater flow to the source, purification capacity of covering sediments and aquifers, water quality and analysis of natural systems.

II.3
Is the list of plots (cadastral parcels) positioned on the DWPZ prepared and it is publicly available or even published in the official documents?

No. The Decision on DWPZ and its cartographic section displaying the borders are publicly available since that is a document adopted by the representative body of a local or regional self-government unit. However, given that there is no obligation to harmonize all borders with cadastral parcels, there is no list of parcels located inside the proclaimed DWPZ. The same applies to some of the second DWPZ for which water research works were conducted and which served as a basis for harmonizing borders with cadastral parcels.

III.
Who and how is exercising control over the surface of DWPZ?

DWPZ are embedded into the physical planning documents as implementation provisions (interdictions and protection measures for each established zone), as well as the graphical representation of the Plan. All operations and activities in the area should be harmonized with the physical planning documents that are checked and confirmed by competent administrative authorities under the applicable legal regulations at national, regional or local level. On the other hand, the situation in the field is verified by the relevant water inspection.

IV.
How the breaches of the requirements defined on DWPZ are penalized?

The relevant water inspection establishes the breaches, while the penalties and inspection responsibilities are laid down in the penalty provisions of applicable laws.
According the Regulation on the conditions for the establishment of sanitary protection zones (Official Gazette no. 66/2011, 47/2013), within 12 months from adopting the Decision on DWPZ it is necessary to draw up a Program of rehabilitation measures within the sanitary protection zones for existing buildings and existing activities which becomes an integral part of the Decision on source protection. The Program of rehabilitation measures contains a list of all pollutants in the area of sanitary protection zones, priority rehabilitation interventions, implementation deadlines for remedial interventions, remediation costs, institutions in charge of financing the implementation of the Program.
The Region of Istria developed the proposal of the above mentioned Program within the DRINKADRIA project.

Country: Serbia

QUESTIONNAIRE
Procedures of drinking water protection zones (DWPZ) implementation

This questionnaire is intended to improve the knowledge of procedures of drinking water protection zones (DWPZ) implementation. It follows out from the already received data and performed analyses as well as discussion in Trieste.

I.
DPWZ are designed based on the field investigations and desk studies. How DPWZ are transferred to the space and how DPWZ are considered in the spatial planning procedures?

I.1
Who are parties with whom DPWZ are discussed (e.g. local communities, water managers, land owners, any other party)?

Responsible: Ministry of Agriculture and Environmental Protection; Ministry of Health; Local authorities, Local Public Utility Companies for waterworks (and sewerage). Water Act, article 77: For local level request for DWSPZs (Drinking Water Source Protection Zone) delineation is submitted by local authorities for specific lots na sites.. More details relevant to this article are provided in summary report submitted previously.
According to Water Act (Official gazette of Republic of Serbia 30/2010 and 93/2012) DWSPZ are protection areas and are defined according to hydrological, hydrolgeological and other natural conditions and characteristics. Also, the type of source or aquifer and source yield are considered, and protection measures and maintenance should sustain drinking water quality standards.

Request for DWSPZ delineation is submitted by local authorities that has jurisdiction on the drinking water source location. If the drinking water source is located within the two or more municipalities, each municipality have to submit request for delineation

Regulation on Establishment and management of drinking water source protection zones (Official Gazette RS, no.92/08) defines DWSPZs delineation and maintenance for locations of water sources and intakes that are with respect to quality and quantity suitable for human consumption (drinking water). According to Regulation, area where the water source is located have to be protected of any intentional and unintentional pollution and other pressures that might have adverse effects on water source yield and natural water quality at the source.

The area and DWSPZs spatial distribution are depicted in the DWSPZ Study. The content of DWSPZs Study is defined in the Regulation on Establishment and management of drinking water source protection zones. After development of Study judgment have to be provided by all relevant institutions in charge for water quality and quantity protection, environmental protection, etc. These activities are organized and coordinated by the local authorities that submitted request for

DWSPZ delineation. Minister of Health declares the Final Decision on Enactment for DWSPZ establishment based on the DWSPZ Study and multidisciplinary commission review and approval. After the final decision is declared appeal against it can be submitted within the 15 days. After that period, the DWSPZ s can be included in water management plans, spatial plans, etc.

I.2
Are borders of DWPZ negotiated and agreed?

Regulation on Establishment and management of drinking water source protection zones (Official Gazette RS, no.92/08) in addition to quality and quantity define and minimum values and borders for DWSPZs relevant for surface and ground water sources , and more details are provide in the before mentioned DWSPZ's Study.
In reality, it is possible to have discrepancy among DWSPZ's natural borders and those delineated and established based on DWSPZ's Study, due to consideration of natural and artificial conditions and constrains within the locality and area that result from compilation of multidisciplinary expert judgement, opinions, or specific reasons justified by authorities.

However, opinion and final decision on DWSPZ's size, perimeters and protection measures declares multidisciplinary expert commission organized by respective Ministry. This decision does not include public participation approach.

I.3
Are interdictions, limitations and measures negotiated?

Prohibitions are included in the Regulation on Establishment and management of drinking water source protection zones and are defined for all (3) DWSPZs. However, they should be considered only as the basic requirements or more like the framework for the activities that should be carefully completed so the real endangerment and pressures for the specific source can be identified. Prohibitions, restrictions and protection measures are in details analysed in the DWSPZ's Study and included in it.

As it was mentioned before, opinion and judgment on DWSPZ's Study is provided by all relevant institutions. Although the literal negotiation is not part of the process, the final decision on Study enactment is based on previously reviewed Study by multidisciplinary commission organized by the Republic of Serbia Ministry of Health or Secretariat for Health of Autonomous province Vojvodina for water sources located in the Northern part of the country declares the final decision on enactment for DWSPZ's Study. These processes do not include public participation.

I.4
Are there any coordinations during this process?

Opinion and judgment on DWSPZ's Study is provided by all relevant institutions. Although the literal negotiation is not part of the process, the final decision on Study enactment is based on previously reviewed Study by multidisciplinary expert commission organized by the Republic of Serbia Ministry of Health or Secretariat for Health of Autonomous province Vojvodina for water sources located in the Northern

part of the country declares the final decision on enactment for DWSPZ's Study. These processes do not include public participation.

I.5
In what extend opinions from the possible procedure must be accepted and how they are accepted?

Area and spatial extension of the drinking water protection zones are proposed and depicted in the DWSPZ's Study. After development of Study judgment have to be provided by all relevant institutions in charge for water quality and quantity protection, environmental protection, etc. These activities are organized and coordinated by the local authorities that submitted request for DWSPZ delineation. Minister of Health declares the Final Decision on Enactment for DWSPZ establishment based on the DWSPZ Study and multidisciplinary expert commission review and approval.

In reality, it is possible to have discrepancy among DWSPZ's natural borders and those delineated and established based on DWSPZ's Study, due to consideration of natural and artificial conditions and constrains within the locality and area that result from compilation of different expert judgement, opinions, or specific reasons justified by authorities.
Finally, DWSPZs 'borders are mapped and included in future solutions for DWSPZs protection.

II.
How DWPZ borders are considered in the space and in the spatial planning process?

II.1
Are borders of DWSPZ drawn so that they are following land plot (cadastral / parcel) borders?

No, there is no legal requirement with respect to that. Thus, adjustment of DWPZs boundaries with cadastre/parcel borders is not mandatory.
According to Regulation on Establishment and management of drinking water source protection zones (Official Gazette RS, no.92/08) boundaries for all 3 DWSPZs in DWSPZ's Study are exhibited with respect to zone area in a following way:
1) DWSPZ I is defined by referring to cadastral lot number or by location of breaking points of polygon presented by the survey coordinates;
2) DWSPZ II and DWSPZ III, are defined by location of breaking points of polygon presented by the survey coordinates;
The natural borders of DWSPZs are based on criteria defined in Regulation on Establishment and management of drinking water source protection zones are within the closed line for proposed perimeter that is specified by survey coordinates.

II.2
Are borders of DWP drawn so that only design criteria are considered, no matter what are the ownership relationships in space?

The ownership of parcels, lots or facilities are not considered during the DWSPZs delineation and establishment in generally. However, s it was previously mentioned anthropogenic influence and natural characteristics (geological, hydrogeological, hydrological, aquifer type, etc) are considered.

II.3
Is the list of plots (cadastral parcels) positioned on the DWPZ prepared and it is publicly available or even published in the official documents?

DWSPZs Maps are publicly available during the devolvement of planning documents and during the conditions definition for development and planning of new and legalisation of existing facilities and buildings.

Conciliation of the DWSPZs boundaries and cadastral lots is not required by law, but during the final stage of DWSPZs establishment it is possible to overlap them to avoid additional complications, definition is easier, it is more practical and applicable, and crossing of DWSPZs and facilities are avoided.

Based on Regulation on Establishment and management of drinking water source protection zones (Official Gazette RS, no.92/08) DWSPZ perimeter is depicted by the data for area size in a following way:

1) DWSPZ I is defined by referring to cadastral lot number or by location of breaking points of polygon presented by the survey coordinates;
2) DWSPZ II and DWSPZ III are defined by location of breaking points of polygon presented by the survey coordinates.

The DWSPZs Study is not published in the Official Gazette at the local level.

III.
Who and how is exercising control over the surface of DWPZ?

DWPZs are included into the spatial planning documents at the local level in the sections that elaborate and describe application and implementation of restrictions and protection measures. DWPZs in those documents are described textually and exhibited on the maps visually.
All activities within the area where the DWPZs are located have to be harmonized with spatial plans and other documents relevant for spatial planning for particular locations. This is reviewed and checked by the adequate authorities as defined in legal framework at different levels (national, regional, local). Competent inspections (water, constriction, health, etc) are observing and verify conditions at the locations within the DWPZs perimeters.

IV.
How the breaches of the requirements defined on DWPZ are penalized?

Violations are designated by relevant inspections. Penalties and jurisdictions are decreed by responding national legal framework. Conciliation and agreement degree of the existing activities, buildings and facilities with valid legal prohibitions and restrictions relevant for drinking water sources protection is realized either during the legalisation or water permits and acts obtaining procedures. For the legal existing

facilities and buildings, any activities after DWPZs delineation and establishment require specific conditions and permit in line with site specific study for DWPZs. The permits are under the jurisdiction of the local authorities and PUCs for waterworks (and sewerage).

General procedures for measures and maintenance are defined and included in By-law on establishment and management of drinking water source protection zones (RS Official Gazette, no. 92/2008). For each DWPZ, breaches are penalized in line with violation type (construction violation, sanitary violation, etc)

Country: Albania

QUESTIONNAIRE
Procedures of drinking water protection zones (DWPZ) implementation

This questionnaire is intended to improve the knowledge of procedures of drinking water protection zones (DWPZ) implementation. It follows out from the already received data and performed analyses as well as discussion in Trieste.

I.
DPWZ are designed based on the field investigations and desk studies. How DPWZ are transferred to the space and how DPWZ are considered in the spatial planning procedures?

I.1
Who are parties with whom DPWZ are discussed (e.g. local communities, water managers, land owners, any other party)?

Decision of Council of Ministers No.416 of 13.05.2015 "On the approval of the general conditions of the special, accompanying documents, term of validity, the application forms for authorization and permission, the decision-making procedures and formats for authorization permit for use of water resources";

Documents to be submitted are:

- Application form
- Hydrological or Hydrogeological report,
- Business Planning,
- Water Use Project
- Opponencies form the Albanian Geological Services,
- Environmental Impact Assessment Report;
- Environmental Permit.

Procedure to take authorization to use water sources for drinking water purposes :

- Water Supply and Sewerage Utility (WSS) or any other interested individual or company, submits the required documents to the River Basin Agency (RBA)
- River Basin Agency (RBA) make the verification of the documents in accordance of the in force legislation
- During the next meeting River Basin Council (RBC) approves the request to use the water source
- Documents of the RBC meeting are sent to be confirmed by the Technical Secretariat of the National Water Council (TSNWC)
- TSNWC verifies the legal compliance of the decision taken by RBC
- The decision disclosures and is sent to the interested entity
- In cases where the amount of water required is greater than 5 l / sec the decision is taken by National Water Council (NWC)

I.2 Are borders of DWPZ negotiated and agreed?

Based on the above mentioned DCM, every subject applying to take permission to use water sources as drinking water, in the hydrological or hydrogeological report must submit also recommended border for the DWPZ and the water resource layout together with the borders of surrounding private properties and their owner's name.

For water uses more than 5 L/sec the decision for the DWPZ is taken from the National Water Consul (NWC) experts, after verifying the proposed borders with the DCM no 145, dated 26.02.1998, for the approval of the "hygiene and health regulation for the control of drinking water quality, the design, construction and supervision of systems of drinking water supply."

I.3 Are interdictions, limitations and measures negotiated?

In cases that in between the proposed DWPZ borders are situated private properties, negotiation are between the NWC, land owners, applying subject (private subject, WSS utility and Municipality). We couldn't find any decision for that!

I.4 Are there any coordinations during this process?

River Basin Agency (RBA) plays the role of the coordinator. This institution makes the connection between the applying subject and approving authority (RBC or NWC).

I.5 In what extend opinions from the possible procedure must be accepted and how they are accepted?

No information about the possible procedure.

II.
How DWPZ borders are considered in the space and in the spatial planning process?

II.1
Are borders of DWPZ drawn so that they are following land plot (cadastral / parcel) borders?

Yes the DWPZ are drawn and follow the land plot but there are not found the specific procedure on how are those borders designed.

II.2
Are borders of DWP drawn so that only design criteria are considered, no matter what are the ownership relationships in space?

No criteria found.

II.3
Is the list of plots (cadastral parcels) positioned on the DWPZ prepared and it is publicly available or even published in the official documents?

There are no publicly available DWPZ plots. The Water Utilities receive it in different

ways.

III.
Who and how is exercising control over the surface of DWPZ?

Water Supply and Sewerage Utility controls the surface of DWPZ from intrusions, vandalism and pollution. While the River Basin Council Controls is responsible to monitor the WSS utility.

IV.
How the breaches of the requirements defined on DWPZ are penalized?

Natural persons and legal entities whose interests are damaged by the determination of hygiene- sanitary protection zones are compensated under the provisions of the Civil Code of the Republic of Albania.

Country: Bosnia and Herzegovina

QUESTIONNAIRE
Procedures of drinking water protection zones (DWPZ) implementation

This questionnaire is intended to improve the knowledge of procedures of drinking water protection zones (DWPZ) implementation. It follows out from the already received data and performed analyses as well as discussion in Trieste.

I. **DPWZ are designed based on the field investigations and desk studies. How DPWZ are transferred to the space and how DPWZ are considered in the spatial planning procedures?**
I.1 Who are parties with whom DPWZ are discussed (e.g. local communities, water managers, land owners, any other party)? Depends. If DPWZ are located in one municipality than it's discussed with the municipality. If it's located on 2 municipalities than it's discussed with canton, if it's between 2 cantons, it's discussed with FBiH or Republika Srpska (depends in which part they are located). If it's located in both entities, then it's discussed with both entities.
I.2 Are borders of DWPZ negotiated and agreed? No. Borders of DWPZ are calculated using hydrological, hydrogeological, geological and hydraulic maps and calculations.
I.3 Are interdictions, limitations and measures negotiated? No.
I.4 Are there any coordinations during this process? As necessary.
I.5 In what extend opinions from the possible procedure must be accepted and how they are accepted? Borders of DWPZ are proposed by the Report of the protection zones and then Decision on water protection zones is made.
II. **How DWPZ borders are considered in the space and in the spatial planning**

process?
II.1 Are borders of DWPZ drawn so that they are following land plot (cadastral / parcel) borders? Yes if there is possibility to do so, but not if it will endanger protection of water source.
II.2 Are borders of DWP drawn so that only design criteria are considered, no matter what are the ownership relationships in space? Design criteria is considered and also ownership relationships in space, where it is possible, as long as it's not endangering the protection of water source.
II.3 Is the list of plots (cadastral parcels) positioned on the DWPZ prepared and it is publicly available or even published in the official documents? Only for the 1. zone it's obligatory to identify cadastral parcels and they are part of the report.
III. **Who and how is exercising control over the surface of DWPZ?** It's defined by the report. For overall control PU is in charge.
IV. **How the breaches of the requirements defined on DWPZ are penalized?** It's defined by the report and regulations.

Country: Greece

QUESTIONNAIRE
Procedures of drinking water protection zones (DWPZ) implementation

This questionnaire is intended to improve the knowledge of procedures of drinking water protection zones (DWPZ) implementation. It follows out from the already received data and performed analyses as well as discussion in Trieste.

I. **DPWZ are designed based on the field investigations and desk studies. How DPWZ are transferred to the space and how DPWZ are considered in the spatial planning procedures?**
I.1 Who are parties with whom DPWZ are discussed (e.g. local communities, water managers, land owners, any other party)? The DPWZ are defined with legislative acts (Programme of measures according to the WFD for each Water District). The exact zones have to be deliminated and further studies have to be elaborated. Hydrological and hydrogeological studies have to be elaborated on behalf of the drinking water supply companies (municipal companies for water supply and sewerage). For water abstraction more than 1 mil. m^3 special hydrogeological studies should be elaborated to define the exact DWPZ borders.
I.2 Are borders of DWPZ negotiated and agreed? The DWPZ borders are defined with legislative acts. Until now these zones are not actually implemented. Related studies have to be elaborated to define the exact borders.
I.3 Are interdictions, limitations and measures negotiated? The limitations and the measures are defined by the legislation (Programme of measures according to the WFD for each Water District).
I.4 Are there any coordinations during this process?
I.5 In what extend opinions from the possible procedure must be accepted and how they are accepted? The DWP zones are not yet implemented.

II.
How DWPZ borders are considered in the space and in the spatial planning process?

II.1
Are borders of DWPZ drawn so that they are following land plot (cadastral / parcel) borders?

The DWPZ borders will be drawn after the elaboration of the related studies.

II.2
Are borders of DWP drawn so that only design criteria are considered, no matter what are the ownership relationships in space?

The DWPZ borders will be drawn after the elaboration of the related studies.

II.3
Is the list of plots (cadastral parcels) positioned on the DWPZ prepared and it is publicly available or even published in the official documents?

N/A. The DWPZ borders (and plots) will be drawn after the elaboration of the related studies.

III.
Who and how is exercising control over the surface of DWPZ?

The authorities exercising control are the Regional Decentralized Administrative Units (through their Water Directorates), the Health departments of the Regional authorities, the Water Utilities.

IV.
How the breaches of the requirements defined on DWPZ are penalized?

They are not defined yet.