



WATER MANAGEMENT STRATEGY OF THE FEDERATION OF BOSNIA AND HERZEGOVINA

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Društvo za istraživanje, studije, projektiranje i konsalting
Zavod za vodoprivredu d.o.o. Mostar

The Government of the Federation of Bosnia and Herzegovina at its 47th session, held on 17 June 2010, adopted and proceeded Proposed Water Management Strategy of the Federation of Bosnia and Herzegovina.

The House of Representatives of the Federation of Bosnia and Herzegovina Parliament, at its 33rd session, held on 20 October 2010, adopted the Proposed Water Management Strategy of the Federation of Bosnia and Herzegovina as drafted and proposed by the Government of the Federation of Bosnia and Herzegovina.

The House of Peoples of the Federation of Bosnia and Herzegovina Parliament at its 5th extraordinary session, held on 20 December 2011, adopted the Proposed Water Management Strategy of the Federation of Bosnia and Herzegovina in the same text.

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6. Middle Bosnia Canton (Canton 6)	Ministry of Forestry, Water Management and Agriculture
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8. West Herzegovina Canton (Canton 8)	Ministry of Economy
9. Sarajevo Canton (Canton 9)	Ministry of Economy. Sector for Agriculture, Water Management and Forestry
10. Canton 10	Ministry of Agriculture, Water Management and Forestry

Water management Strategy of the Federation of Bosnia and Herzegovina

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1. Background Information on the Relevant Area

1.1. Position, Social and Political Framework

1.1.1. Basic Indicators

Bosnia and Herzegovina, by its geographical position, is located at the borderline of two climate zones of the Western Balkan Peninsula. It covers the total area of 51,209.2 km², out of which 51,197 km² is land and 12.2 km² is sea.¹ The climate is mostly continental, while southern parts of the country have Mediterranean-type climate. The official name of the country is “Bosnia and Herzegovina” as set out in the General Framework Agreement for Peace that became effective in 1995. The country is comprised of two entities: the Federation of Bosnia and Herzegovina (BiH Federation) and Republika Srpska (RS), as well as Brcko District (BD). The geographical coordinates of the far ends of Bosnia and Herzegovina are as follows:

Position	Northern geographical latitude	Eastern geographical longitude	Municipality/Settlement
North	45° 16' 30"	16° 55' 56"	B. Dubica/Gradina D.
South	42° 33' 00"	18° 32' 24"	Trebinje/Podštirovnik
East	44° 03' 00"	19° 37' 41"	Bratunac/Žlijebac
West	44° 49' 30"	15° 44' 00"	Bihać/Bugar

Table 1. 1.1: Geographical coordinates of the far ends of Bosnia and Herzegovina

(Source: Geodetic, Property and Legal Affairs Administration of BiH – (Bos. *Uprava za geodetske i imovinsko-pravne poslove BiH*)

The Federation of Bosnia and Herzegovina, being one of the entities, was created by signing the Washington Agreement between the Republic of Croatia and the Republic of Bosnia and Herzegovina on March 18, 1994. At the Constituent Assembly session held on March 30, 1994, the Constitution of the Federation of Bosnia and Herzegovina was adopted. This Assembly ceased to exist in 1996 after the parliament of the Federation of Bosnia and Herzegovina was established. The Federation of BiH covers 26.127 km².

Administratively, the Federation of BiH is consisted of ten Cantons, as set out in the Law on Federal Units², while the names and administrative centres of the Cantons are set out in their respective constitutions, as follows:

- Una-Sana Canton, with its administrative centre in Bihać (Canton 1);
- Posavina Canton, Orašje (Canton 2);
- Tuzla Canton, Tuzla (Canton 3);
- Zenica-Doboj Canton, Zenica (Canton 4);
- Bosnian Podrinje Canton, Goražde (Canton 5);
- Middle Bosnia Canton, Travnik (Canton 6);
- Herzegovina-Neretva Canton, the City of Mostar (Canton 7);
- West Herzegovina Canton, Široki Brijeg (Canton 8),
- Sarajevo Canton, the City of Sarajevo (Canton 9),
- Canton 10, Livno.

¹ Agency for Statistics of Bosnia and Herzegovina: „www.bhas.ba“

² Official Gazette of FBiH, No. 9/96

Organizationally, the Cantons are divided by municipalities and there are total of 79 municipalities on the territory of the Federation of Bosnia and Herzegovina. The figure below represents an illustrative outline of the respective Cantonal areas within the Federation of BiH.



Figure 1 1.1: Cantons of the Federation of BiH

1.1.2. Population

As is known, in Bosnia and Herzegovina there has been no official census since 1991. All data published after 1991 were based either on limited local censuses and polls covering small areas or on expert analyses and assessments.

It should be emphasized that the period following 1991 was marked by turbulent demographic movements. In addition, the political and social changes that took place during this period largely complicate the assessment of the current demographic situation, and in particular, the projections for the upcoming period. The territory of the Federation of BiH was stricken by migration changes involving thousands of citizens, which from a demographic point of view, took place in a very short period of time. When observing the population growth rate in Bosnia and Herzegovina for the last 40 years, several distinctive stages may be noticed:

- Until 1970s, the demographic dynamics were characterized by high population growth rates;
- From 1970s until 1990s, regardless of the population growth, the annual growth rate was smaller;
- From the second half of 1990s, according to the assessments, there was another, slightly milder growth, which was, however, significantly smaller than any of the growth rates recorded in earlier periods.

1.1.2.1. Demographic Developments until 1991

The table and the chart below show the demographic developments in Bosnia and Herzegovina according to the results of the conducted censuses. According to the results of the last census, that took place in 1991, Bosnia and Herzegovina had population of 4.377.033 residing on the territory of 51.197 km^{2,3}.

Year of Census	Size in km ²	Population	Population density per km ²
1879	51,246	1,158,440	22.6
1885	51,246	1,336,091	26.1
1895	51,246	1,568,092	30.6
1910	51,200	1,898,044	37.1
1921	51,200	1,890,440	36.9
1931	51,564	2,323,555	45.1
1948	51,189	2,564,308	50.1
1953	51,221	2,847,459	55.6
1961	51,197	3,277,948	64.0
1971	51,197	3,746,111	73.2
1981	51,197	4,124,256	80.6
1991	51,197	4,377,033	85.5

Table 1.1.2: Outline of the changes in the BiH population according to the censuses conducted in the period 1879-1991

1.1.2.2. Demographic Developments in the Period 1991-2007

As stated above, in addition to the lack of census, this period is characterized by major demographic movements. The 1991-1995 war period caused destructions and brought large consequences that are measurable or immeasurable in population, property, economic capacities and social and municipal infrastructure. The consequences on people are the most severe ones and they reflect in losses, population outflows (especially the most economically active population), as well as in deterioration in psychological and physical health condition. The population suffered changes by migrations, movements of displaced persons and refugees, while the economic, educational and urban and rural structure has also been altered.

The assessments associated with the population in the period 1996-2007 have been taken out of the publications issued by the Federal Office of Statistics Sarajevo⁴

It should be noted that in the period following 1995, new municipalities have been formed in the Federation of BiH, as follows: Bužim in Una-Sana Canton, Domaljevac in Posavina Canton; Čelić, Doboje-East, Sapna and Teočak in Tuzla Canton; Doboje-South and Usora in Zenica-Doboje Canton; Foča and Pale in Bosnian Podrinje Canton and Dobretići in Middle Bosnia Canton. In addition, the 1991 boundaries of certain municipalities have changed. All of these changes have been taken into consideration and according to the data issued by the above-mentioned Office of Statistics, the population in the Federation of BiH (the population permanently residing in FBiH), in the period 1991–2007 is shown in the chart below (see Figure 1.1.2.).

³ The data refers to the size of the BiH land of 51,197 km², while the BiH covers total of 51,209.2 km²

⁴ Federal Office of Statistics Sarajevo „www.fzs.ba”

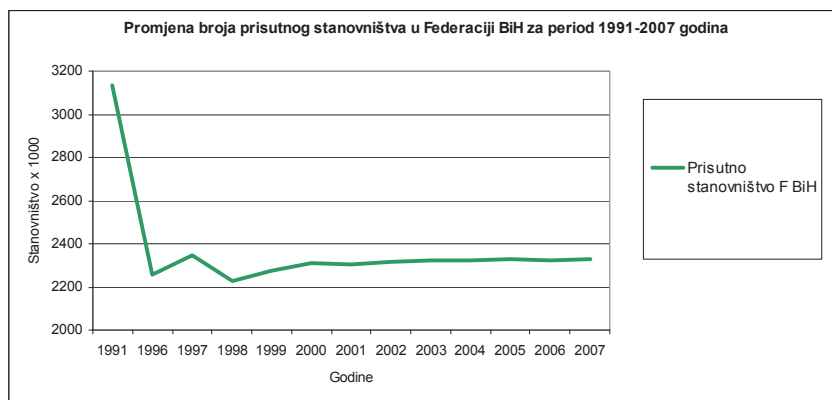


Figure 1.1.2: Chart showing the changes in the population of the Federation of BiH in the period 1991-2007 (Source: Federal Office of Statistics Sarajevo)

As presented in the data chart above, the permanently residing population in the observed period has not been changing significantly and it is around 2,300,000, which is, compared to 1991 population, a decrease by approximately 26%. By comparing the 2007 population with the 1991 population by Canton, the following chart may be drawn:

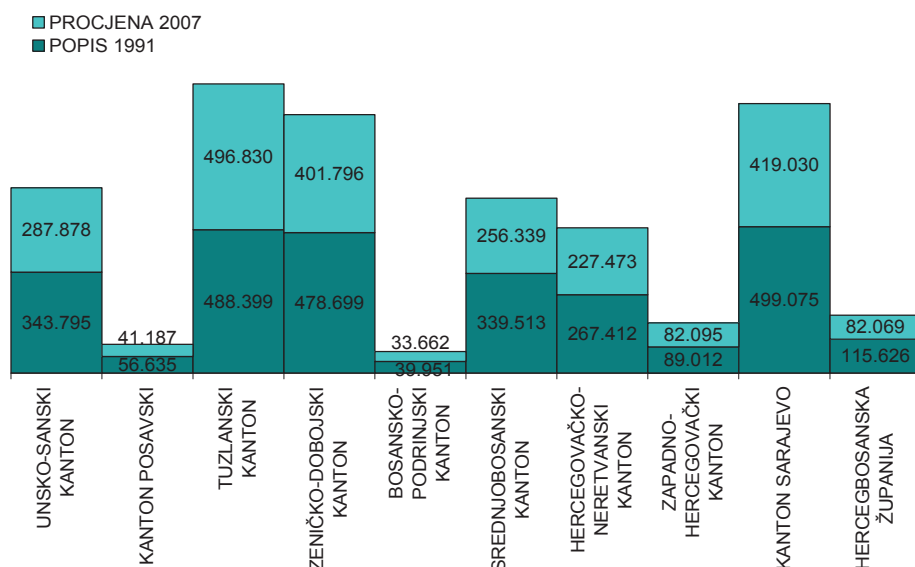


Figure 1.1.3: Chart showing the ratio between 1991 population based on the census and the 2007 population based on the assessment

Currently, the largest population density in the Federation of BiH is in the central and north-east parts of the territory, or more precisely, Sarajevo Canton with population density of approximately 325 per km² and Tuzla Canton with population density of approximately 185 per km², where 15% of the territory is occupied by approximately 40% of the total population of the Federation of BiH. In other parts of the territory the situation is relatively favourable, save for Canton 10, where on

19% of the total territory of the Federation of Bosnia and Herzegovina, the population density is only 16.6 per km².

The population distribution by settlements can be presented only for 1991 according to the census results⁵. The figure below provides a graphical interpretation of the size of inhabited areas within the territory of the Federation of BiH.

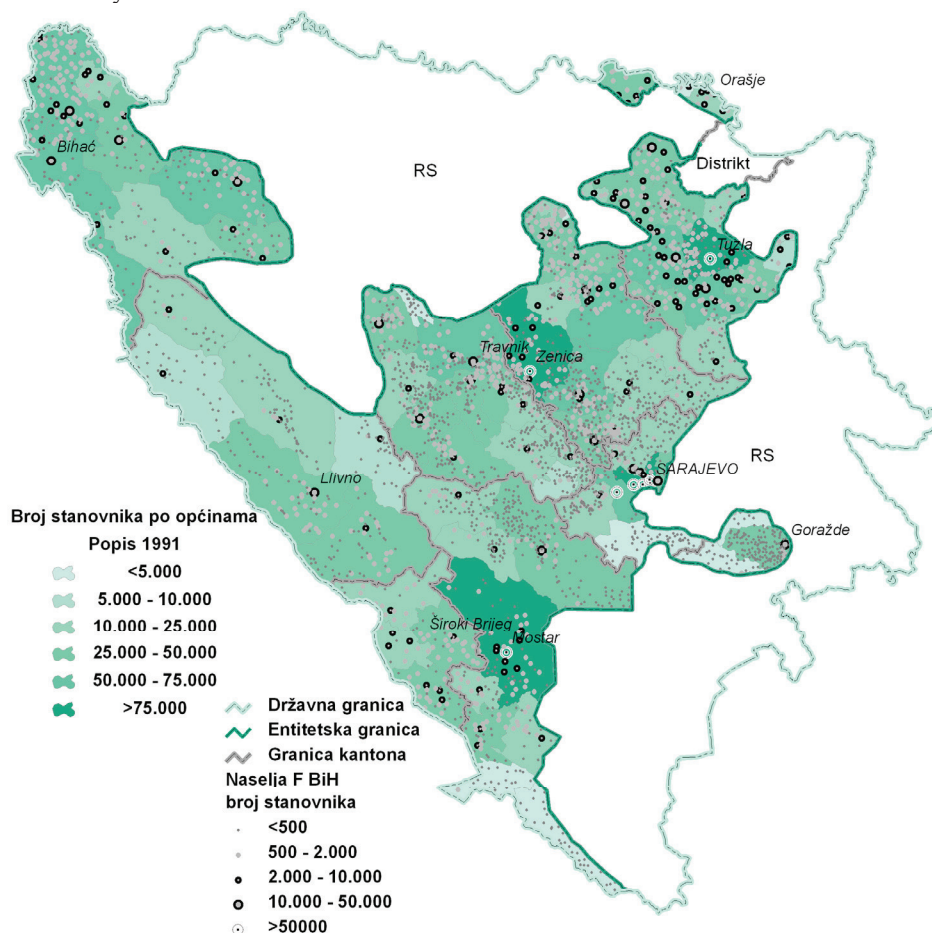


Figure 1.1.4: Population and size of the settlements by municipality (1991 census)

⁵ The assessments related to the population for the period 1996-2007 is available only for municipalities at the Federal Office of Statistic

The population distribution by river basin district, i.e. by river basin and sub-basin in the Federation of BiH is presented in the tables below.

Relevant district:	Population	
	1991 Census	1997 Assessment
Una river sub-basin with the rivers Glina and Korana	364,597	302,488
Vrba river sub-basin	160,762	120,868
Bosna river sub-basin	1,544,386	1,341,727
Drina river sub-basin	63,410	57,526
Immediate Sava river basin	144,988	135,557
Total Sava River Basin District	2,278,143	1,958,166

Table 1.1.3: BiH Federation population on the Sava River Basin District

Relevant district:	Population	
	1991 Census	1997 Assessment
Neretva river basin with Trebišnjica	359,060	311,262
Krka and Cetina rivers basin	81,615	58,084
Total Adriatic River Basin District	440,675	369,346
Total BiH Federation	2,718,818	2,327,512

Table 1.1.4: BiH Federation population on the Adriatic River Basin District

1.2. Natural Characteristics

1.2.1. General Indicators

Geological structure and *petrographic composition* of the terrains in the Federation of Bosnia and Herzegovina came as a consequence of a long geological past resulting in creation of magmatic, sedimentary and metamorphic rocks, as well as considerable ore mineralisation. The relief has been developing throughout the Palaeozoic, Mesozoic and Cainozoic Eras. The hydrographic outflow properties are significantly influenced by the presence of a well-developed karst zone.

The hydrological properties are significantly influenced by geomorphologic and hydro-geological factors, as illustrated in the following statements:

- The barrier effects of Dinarides intersecting the moist air masses from the Mediterranean basin cause air lifts, rapid air cooling and precipitation. Therefore, the precipitation is most intense at the foot of Dinarides, as far as Bosnia and Herzegovina and the Federation of BiH are concerned;
- Such a system of precipitation occurrence is linked to the karst zone position, with its large underground hydrological retention potentials.

In these circumstances and with a favourable boundary contact zone with hydro-geological insulators, all springs of the significant watercourses emerge within both River Basin Districts in the Federation of BiH. If there had been the same geomorphologic and precipitation-related features, and no karst zone, the water regimen in the Federation of Bosnia and Herzegovina, as well as in Bosnia and Herzegovina as a whole would have been considerably less favourable.

1.2.2. Lithographic and Tectonic Features

The Federation of Bosnia and Herzegovina rests on several different paleogeographic and structural units that are distinctive by their respective composition, structure and genesis. In southwest-northeast profile, from the Adriatic Sea to the Sava River, the following paleogeographic and structural units may be noticed, as shown in Figure 1.2.1.:

- Adriatic Carbonate Platform (External Dinarides) - mostly covers the catchment area of the Adriatic Sea, and smaller part of the catchment area of the Sava River; ;
- Alochthonus Palaeozoic and Triassic complexes whose smaller part belongs to the catchment area of the Adriatic Sea and larger – the catchment area of the Sava River. The Adriatic Sea basin covers south-west parts of the mountains Zec, Bitovnja and Bjelašnica (Neretva River basin). The Sava River basin covers Palaeozoic and Triassic terrains of the areas of Ključ, Sanski Most, the mountains Vranica, Igman and Bjelašnica, and wider area of Sarajevo and Goražde;
- Ophiolite zone that encompasses Mountain Ozren and Mountain Konjuh (typical non-karst terrains where basic and ultra-basic rocks prevail) – the Sava River Sub-Basin;
- Sava and Vardar zone (Tuzla Canton and Posavina Canton) – the Sava River Sub-Basin;
- Within these paleogeographic and structural units, there are post-orogenic, oligocenic, neogenic and quarternary formations where considerable water bodies of intergranular porosity were formed.

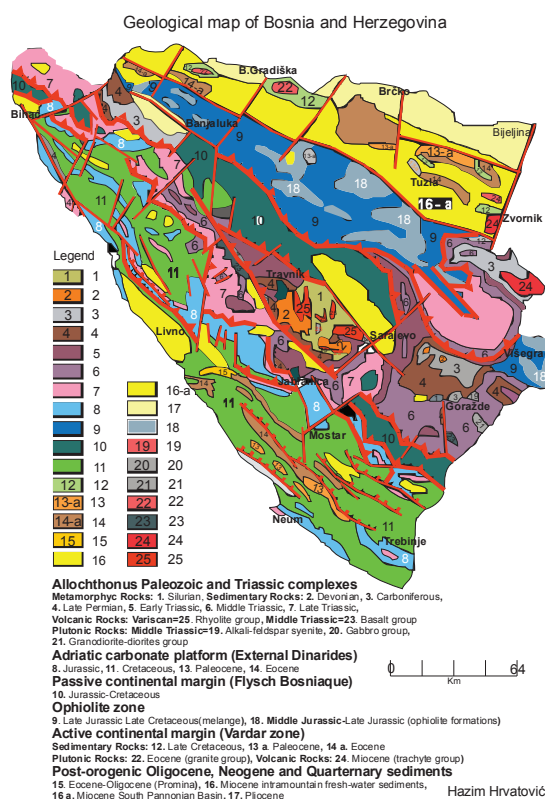


Figure 1.2.1: Comprehensive geological map of Bosnia and Herzegovina with main paleogeographic and tectonic units (Hrvatović, 2000).

Legend:

Alocthonous Palaeozoic and Triassic complexes

Metamorphic Rocks: 1. Silurian (greenschist facies), **Sedimentary rocks:** 2. Devonian (limestone and dolomites), 3. Carboniferous (clastic sedimentary rocks), 4. Late Permian (clastics, evaporites, limestone), 5. Early Triassic (clastics and some limestone), 6. Middle Triassic (limestone, and some dolomites), 7. Late Triassic (limestone and dolomites).

Volcanic Rocks: Variscan (Palaeozoic) = 25. Rhyolite group, Middle Triassic = 23. Basalt group

Plutonic Rocks: Middle Triassic = 19. Alkali-feldspar syenite, 20. Gabbro group, 21. Granodiorite-diorites group.

Adriatic Carbonate platform (External Dinarides)

8. Jurassic (limestone and dolomites), 11. Cretaceous (limestone), 13. Palaeocene (limestone), 14. Eocene (Flysch),

Flysch Bosniaque (Passive continental margin)

10. Jurassic-Cretaceous flysch sediments

Ophiolite zone

9. Late Jurassic Late Cretaceous ophiolite mélange (sandstone, claystone, alevrolite, cherts, diabase, gabbros, serpentinite, limestone, conglomerate), 18. Middle Jurassic-Late Jurassic ophiolite formations (basic and ultra-basic rocks)

Sava and Vardar Zone (active continental margin)

Sedimentary rocks: 12. Late Cretaceous (Flysch – partly metamorphosed), 13.a. Palaeocene (limestone and clastics), 14.a. Eocene (Flysch)

Plutonic rocks: 22. Eocene (granite group), Volcanic rocks: 24. Miocene (trachyte group)

Post-orogenic Oligocene, Neogene and Quaternary sediments

15. Eocene-Oligocene (conglomerates and sandstones), 16. Miocene Intramountain fresh-water sediments with coal layers, 16.a. Miocene sediments of South Pannonian Basin (marine sediments), 17. Pliocene

The text below provides a description of the main geological and tectonic characteristics of the above-listed units.

- **Adriatic Carbonate Platform** *Adriatic Carbonate platform – External Dinarides*, encompasses the area North-East of the coast of Adriatic Sea, known under the name of High Karst or Karst Dinarides. It is the area of over 300 km in length and 80-200 km in width (after tectonic reduction). Long carbonate sedimentation (from Middle Triassic to Middle Eocene and in some parts even from Late Permian) was characteristic in this area which resulted in creation of very thick deposits of carbonate sediments in which large bodies of groundwater are located with important springs as is the spring of River Buna, Bunica, Klokot, Klokun and many other. Within the Adriatic Carbonate Platform numerous tertiary paleodepressions were formed, i.e. Neogene sedimentation basins where during the period of Oligocene-Pont fresh-water lakes existed. According to the facial type and lithological characteristics of sediments created in these basins (clay, sandstones, breccia, conglomerates, coal and limestone), they significantly differ from the composition of carbonate platform; however, according to the hydrogeological function, size and influence on development of karstification processes within the carbonate platform, these basins represent its significant elements. Neogene basins are treated as special paleogeographic-structural unit developed in wider area of BiH. In the areas of Adriatic Carbonate Platform, these are the following units: Cazin-Bihac, Drvar, Glamoc, Kupres, Livno, Duvno, Mostar, Nevesinje and Gacko basin.
- **Flysch Bosniaque** (Blanchet, 1969; Aubouin et al., 1970), also known as Sarajevo-Banja Luka flysch zone (Mojicevic, 1975), was deposited on the slope of the Adriatic Carbonate Platform and on its foot (Pamic et al., 1998). In Flysch Bosniaque, which is around 3,000 m thick, two groups of formations can be distinguished (Olujic, 1980). In the map legend these are marked as number 7 and 8.

The older, Vranduk group, is characterised by alternating of non-flysch shales “para-flysch” and turbidite sequences which are mainly composed of micrites, arenites, shales, and in some places interstratified with radiolarites as a result of pelagic incursions; this unit is of Liassic to Berriasian age. This group of formations largely contains ophiolitic detritus what indicates that the

area of its creation was in the area before obducted ophiolite. This group of formations is composed of mixed carbonate-silicate rocks.

The younger, Ugar group of formations represents the first carbonate flysch which is mostly composed of materials from carbonate platform of External Dinarides. They lay discordantly over the Vranduk group. This unit is of Albian to Senonian age, in some places it also contains Early Paleogene microfossils, and is known in literature as Durmitor flysch.

In hydro-geological sense, lithological composition of these flysch formations determined their hydrogeological function, so the complex of Jurassic-Cretaceous flysch (Vranduk group) is defined as hydrogeological complex with impermeable function without aquifer while Cretaceous carbonate flysch (Ugar group) is defined as hydrogeological complex of mixed porosity.

- **Allochthonous Palaeozoic and Triassic complexes** disturb the regular zone layout of Dinaric paleogeographic-structural units. These units mostly comprise of Palaeozoic metasediments and metavolcanics which are covered with Perm sediments. In addition to Palaeozoic formations, there are many Triassic limestone and dolomites with subordinated synchronous magmatic and clastic rocks.

Palaeozoic and Triassic complexes are represented in Sana-Una, Mid-Bosnian and Southeast Bosnian allochthonous masses.

The territory of Bosnia and Herzegovina Federation encompasses small area of well known Palaeozoic **Sana-Una area**. These are terrains near Sanski Most, Sanica and Ključ and they belong to Carboniferous, Late Perm and Early Triassic.

Mid-Bosnian Schist Mountains (Vranica, Kruscica, Radovan, Bitovnja, Zec and Berberusa), *sensu lato*, include the mountains which are mostly composed of crystal schist. The oldest structures are metamorphic rocks originating mostly from sediment complex of Silurian and Ordovician age. Schist complexes mostly belong to greenschist facies of lower level of metamorphisms and in smaller degree to transitional epidot-amphibolite facies. The following metamorphic rocks were singled out: quartz-schist, muscovite, phyllite, chlorite, otrelite, amphibole and graphitic schists; metasandstones, quartzites, dolosparites marbled limestone and marbles. The listed parametamorphics are mostly characteristic for the areas of Busovaca, Fojnica, Vitez and Vranica. However, limited areas can be noticed of carbonate sedimentation created from limestone, dolomite and marble (Vranica) which have the character of Karst area and in which the body of groundwater is located.

Southeast Bosnian area comprises of the areas of Foca, Gorazde and Praca. The oldest formations, Late Palaeozoic, are discovered between Foca and Gorazde in which Variscan direction of stretch of layers is preserved. Thick-bedded limestone (Spasov and Filipovic, 1966, and Kulenovic 1977) with conodonts of Late Silurian (Ozarkodina, Panderodus) is discovered near Ustikolina.

- **Dinaride Ophiolite Zone** covers the largest part of Internal Dinarides and is composed of the following units (Pamić, 1982; Pamić et al., 2002):
 - a) radiolarite formation of Middle/Late Triassic to Early Cretaceous age, represents bed-to-bed sequences composed largely of radiolarites and shales with subordinate micrites and basalts.
 - b) Late Jurassic olistostrom ophiolitic melange or wildflysch, in older literature known as Diabas-Hornstein Formation, is more than 1 km thick. This formation represents a chaotic creation composed of silty-clay matrix with fragments of greywacke, ophiolite and with subordinate

cherts, shale, schist and exotic limestone which are mostly of Triassic age. Upper level of melange is metamorphic as a result of conductive heat generated by obduction of warm and younger ultramafic geological bodies. This metamorphism is of late Jurassic age.

c) Ultramafic massifs are preserved as relict of oceanic crust floating in the thick ophiolite melange (parts of mountain Konjuh and Ozren). Parts of ultramafics (lherzolites and harzburgites) are serpentinized. Upper parts of ophiolite sequences were eroded when creating the crust of decomposition of serpentinite enriched with cobalt and nickel (area of Gornje Zivinice). Depositing over the crust of decomposition are younger sediment continental and marine formations.

d) Sediment formations transgressively overlaying the ophiolite can be categorised into two main formations: Pogari Formation (Jovanovic, 1957) and reefal limestone near Olovo and on Vijenac near Lukavac.

The Pogari Formation, in its lower levels, is represented by clastics (conglomerates, coarse-grained sandstones, breccia) originating from detritus from Jurassic ophiolite zone, but also with characteristic Palaeozoic red granites found in conglomerates. Concordantly overlaying these clastics (upper levels of Lower Cretaceous) are Upper Cretaceous rudist limestone (area around Zepece and Zavidovici).

Reefal type of limestone is discovered near Olovo (area around Stupcanica and Vijenac near Lukavac) and represents fossiliferous from Late Jurassic to Lower Cretaceous shallow-water limestone representing the beginning of forming a smaller, isolated, carbonate platform which in its basis has ophiolite.

- **Sava-Vardar Zone** is the area between South Tisja and Internal Dinarides mainly covered by Neogene sediments of the Pannonian Basin. Pre-Neogene formations are preserved in the area of Trebovac and Majevisa. Sava-Vardar zone consists of Late Cretaceous to Paleogene flysch units which are intruded with Paleogene granitoids, followed by ophiolite units, tectonised melange and bimodal volcanism.

Post-orogenic Oligocene, Neogene and Quarternary Formations In the present structure of Dinarides, Oligocene-Miocene marine to fresh-water sediments originating after the final structuration of Dinarides, which took place during Eocene deformation phase, have very important role. In Bosnia and Herzegovina there are more than 150 small and large fresh-water basins with coal deposits out of which the best known in Bosnia and Herzegovina are Sarajevo-Zenica, Bugojno, Kamengrad, Livno, Tuzla and Mostar Basin.

Within the area of Bosnia and Herzegovina Federation, in selected fresh-water Neogene basins, the sediments are represented by marl-clay sediments, and rarely by conglomerates, sands, limestone and coal which are exploited. Most frequently found within these basins as top deposits are plio-quaternary sands and clayish sands with subordinate gravels.

1.2.2.1. Neogene Basins in BiH Federation

In the present structure of Dinarides, Oligocene-Miocene marine to fresh-water sediments originating after the final uplift of Dinarides, which took place during Eocene deformation phase, have very important role. In Bosnia and Herzegovina there are numerous small and large fresh-water basins with coal deposits or without them which are located in all geotectonic and paleogeographic units and can be zoned as follows:

- Neogene basins of carbonate platform (Glamoc, Livno, Valley Srdjevicke, Valley Bijelo, Duvno Valley, Kupres Valley, Suice Valley, Mostar, Bihac, Drvar, Cazin, etc.),

- Neogene basins between Mid-Bosnian Schist Mountains and Dinaric Ophiolite Zone (Sarajevo-Zenica Basin, Bugojno Basin, Sana-Kamengrad Basin, etc.),
- Neogene basins of Internal Dinarides created between Dinarides Ophiolite and Sava-Vardar Zone (Tuzla Basin, Gracanica, Banjaluka Basin, etc.),
- Especially important for a range of functions of hydrological and hydrogeological character are complex systems of Mostar Blato, Hutovo and Busko Blato.

Lithofacial characteristics of these basins are very diverse due to intensive orogenic activities in that period and cyclic changes of conditions of sedimentation but, in general, all types of clastics are dominating (clay, marl, sands, conglomerates, etc.) with carbonate sequences (limestone) and noticeable phases of formation of coal deposits.

Each of these basins significantly influence regional and local hydrogeological relations and are part of the system of groundwater circulation; from the aspect of hydrogeological character of the bed on which they were formed, it is important to distinguish:

- Neogene basins on carbonate karstified bed,
- Neogene basins on clastic impermeable bed.

In the area of carbonate platform, Neogene basins comprise significant area as Karst valleys and some of them located on the territory of BiH Federation will be mentioned here because of their size and importance in establishing the system of groundwater circulation, i.e. forming groundwater bodies in the area of Adriatic Carbonate Platform.

Depending on local geological circumstances and hypsometric location, Neogene basins and impermeable sediments comprising them have different role within hydrogeological composition of Karst areas. They primarily function as partial (hanging), local or total barriers to movement of groundwater, directing their movement and most often determining the underground hydrogeological watersheds. Thus, for example, Neogene of Duvno Valley directs water to two sides: towards springs of Rama and Sinj Valley while Neogene of Livno Valley forms the second barrier which, on the other hand, does not fully retain water from hinterland. In this way the sediments, together with structural-tectonic disturbances and their consequences, directly influence the position in space and depth of karstification, in particular since many basins are of quite large capacity: from 500 to 2000 m.

Watersheds between River Basin Districts of Cetina, Krka and Neretva, within the Adriatic River Basin District, are a result of complex effects of numerous factors among which important is the location of rock masses with the function of hydrogeological complex, and lake sediments of Neogene in general can be considered as such, i.e. "Promina sediments" developed in this area. On their way towards the lowest erosion basis, part of groundwater faces barriers of Neogene sediments several times, appears on their surface and flows over (and partially even through) them so as to enter the underground area again on the opposite side of the valley and continue to flow towards a lower level. Five horizons on which groundwater surfaces were identified: Kupres Valley (1,117 to 1,160 mnm), Suice Valley (cca 915 mnm), Glamoc and Duvno Valley (around 860 mnm), Livno Valley and Busko Blato (around 700 mnm), as well as Sinj Valley (around 300 mnm). Two main direction of groundwater circulation have been identified: Western direction with cascades Glamoc – Livno – Sinj Valley and Easter, more impressive, direction which goes over Kupres, Suice, Duvno Valley and Busko Blato to Sinj Valley.

1.2.2.2. Main Thrust Structures of the Dinarides

Apart from small-scale tectonic complexities, it can be seen that all large paleogeographic and structural units are thrust one on top of the other with the External Dinarides unit and Sava-Vardar Zobe corresponding to the lowest and the highest unit respectively. These large-scale fold-and-thrust structures of Dinarides are deformed since Late Jurassic up to Eocene deformational phase. Having in mind this fact, the main thrust structures of Dinarides (Figure 4.3) can be divided into three main groups (which generally represent the paleogeographic units of the Dinarides):

Thrusts arising from movement of Adriatic Carbonate Platform which are characterised by relatively simple geometry and moderate length of movement (Karst and Una-Glamoc-Dreznica-Gacko Nappe).

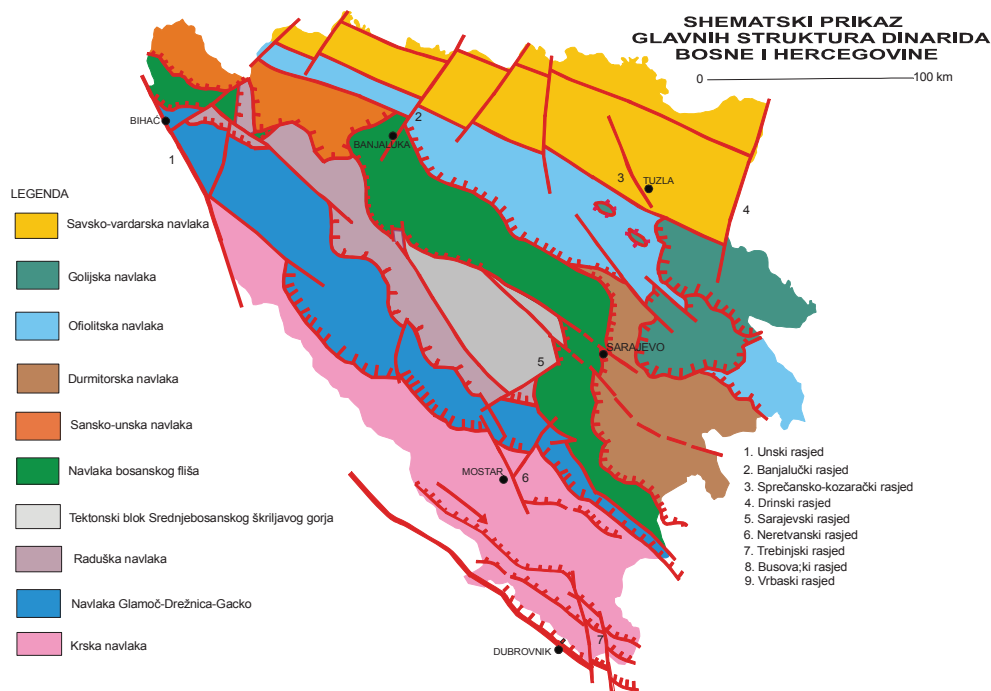


Figure 1.2.2: Main structures of Dinarides of Bosnia and Herzegovina

Thrusts arising from movement of Dinaric part of Tethys which are characterised by complex geometry and significant length of transport (Bosnian flysch, Ophiolite and Sava-Vardar nappe).

Thrusts arising from movements of Palaeozoic-Triassic units, which are also characterised by complex geometry and length of movements of over one hundred kilometres (Durmitor, Golija, Sana-Una, Ključ-Radusa Nappe).

The frontal parts of these thrust-nappe structures can be traced for hundreds of kilometres. Each of these thrust-nappe structural (first order thrusts) units are internally folded, faulted and dissected into second order thrust which can be traced for up to 50 kilometres.

▪ **Main Fault Structures of Dinarides.** In clearly distinguished nappe structure of Dinarides, the following faults can be distinguished:

- Dip-slip faults,
- Post-collision horizontal and normal faults – first order faults (neotectonic active faults),
- Gravitation and reverse faults of second order.

Identified dip-slip faults cut through the entire Earth crust or its large parts. Main direction these faults stretch in is Northwest-Southeast while also observed are faults whose direction of stretching is Northeast-Southwest, and they probably represent the borders of magnetic anomalies. Locations and lasting activity of dip-slip faults has significant role in shaping geology. Obviously, they have a link between geotectonic units, magmatism and metallogeny, geothermal energy, gas and oil deposits, and are especially important for seismic activity of the area of Bosnia and Herzegovina.

Dip-slip faults have almost vertical position and their direction of stretching corresponds with the direction of stretching of geotectonic units and neotectonic zones. Surface geology and reoccurring seismic activity indicates their distinguished neotectonic activity.

1.2.3. Forest Condition

The total forest growing stock on the territory of the Federation of Bosnia and Herzegovina maintained its natural structure, although the forest resources have been considerably degraded in the period between 1970 and 1995. The natural growing stock structure will be maintained in the future as well, through professional and prudent management, while natural reforestation will stimulate, and management sustainability enhance biological diversity, which will by and large improve generally beneficial and polyvalent forest functions. Forest resources, due to their exceptionally long reproduction period, as well as, on the other hand, the high national interest in this industry branch require special attention. In the current context of living, the demand for using the polyvalent functions of forests has become higher, in particular through distinguishing:

- Protected forests,
- Protective forests and
- Special-purpose forests.

Protected forests are special-purpose areas in the sense of preservation of seed-stand and ecosystem monitoring. *Protective forests* are given special importance and role in the preservation of springs, particularly, drinking water springs and watercourses, conservation of surface waters, protection against incidental pollutions, protection against negative influences of surface soil erosion caused by precipitation, prevention of landslides, etc. *Special-purpose forests* represent the starting point for establishing nature reserves, national parks, nature monuments and protected landscape areas. For the purpose of pointing out the importance of the above-mentioned functions of the forests, the following table provides an overview of the structure of forests and forest lands in the Federation of Bosnia and Herzegovina.

Broad Category of Forests and Forest Lands	Size (ha)	Size in percentages (%)
High Forests with natural reforestation	514,244	40.1
High Degraded Forests	16,912	1.3
Forest Plantations with Estimated Timber Volumes	51,251	4.0
Forest Plantations without Estimated Timber Volumes	13,217	1.0
TOTAL HIGH FORESTS	595,624	46.4
Coppice Forests	252,703	19.7
TOTAL STOCKED FOREST LAND	848,327	66.1
Bare land suitable for re-forestation	185,803	14.5
Bare land unsuitable for re-forestation	121,468	9.5
TOTAL NON-STOCKED FOREST LAND	307,361	24.0
TOTAL FOREST MANAGEMENT AREA	1,155,598	90.1
Areas under minefields (all categories)	127,129	9.9
TOTAL (indisputable):	1,282,727	100.0

Table 1.2.1.: Forest resources breakdown on the territory of the Federation of Bosnia and Herzegovina

1.2.3.1. Forest Management in the Context of Water Protection

The surface waters and groundwater, being natural resources, are to a large extent influenced by forest management measures. For instance, different types of logging influence the water content and dynamics in surface and deeper layers of pedosphere. In the flat areas that are typical for the immediate Sava River basin, occurrence of mudflat areas or excess water in the agricultural production areas is possible. In such areas, with the same types of soil, where adequate forest vegetation is present there is no occurrence of mudflats. When it comes to the water dynamics, it is typical that regular selection logging and thinning have influence on increasing water reserves in soil, while tree crowns protect the soil against overheating and evaporation of water.

One of the most important ecological functions of the forests is water protection. The Law on Forests of the Federation of BiH⁶, section 5 in Articles 38, 39, 40 and 42, describes the forests that are subject to special management regime. According to this Law, the forests that are subject to the special management regimen include protective forests, special-purpose forests and karst forests.

In the immediate Sava River basin, a major water polluter is agriculture (mineral nutrients, plant protection agents – herbicides and pesticides, organic components, fuel and lubricant remains, etc.), given that this is dominantly agricultural area. Since there is water pollution hazard, forest vegetation and soil, particularly its buffer features have an important role. The integrated activity of these two factors mitigates or prevents negative influence on the surface waters and groundwater. Particularly important is the role of forest systems that through their metabolic functions of root system and their above ground portions, especially green portions (leaf surface has the role of mitigator and absorbent of adverse effects), provide indirect protection against pollutants that can be suspended in precipitation waters. In the immediate Sava River basin, deciduous forests are dominant, and therefore the water protection effects during vegetation season are significantly stronger. In addition to this type of function, the forest systems are important regulator of water regimen and equalization of high groundwater levels. In the areas where forests are converted into agricultural land, there are problems associated with excess and high levels of groundwater, which creates the necessity of constructing drainage systems.

⁶ Official Gazette of FBiH No. 20/02

In the areas of the *Una River sub-basin with Korana and Glina Rivers*, Triassic karst terrains prevail accompanied with numerous cavernous and fracture aquifers, and therefore, the protective role of forests is exceptionally important in terms of deep soil erosion processes and muddiness of source waters after abundant precipitations. The effect of protecting underground aquifers against muddiness caused by deep soil erosion through fracture systems that is ensured by the forests present in this river sub-basin is exceptionally important because in this river sub-basin there are karst sources of considerable yield. In addition to this one, the forests have an important role in equalization and mitigation of peak flows and equalization of water regimen. In the areas without forest vegetation there are high oscillations in water dynamics due to large temperature fluctuations. In a part of the river sub-basin, there are water aquifers of intergranular porosity, and consequently, in these areas as well, the forest vegetation has a significant role in the processes of surface flow speed equalization and percolation of precipitated waters. Particularly important is the role of high mixed forests in terms of their protection against erosion onset and intensive erosion processes. The calculations related to the adverse effects of forest systems on water dynamics, particularly in the karst regions, are incompliant with the objectives of a long-term sustainable water management.

In the areas of the *Vrba River sub-basin*, the high mixed forests have a crucial protective role with respect to surface and underground aquifers. This especially applies to the protective role of the areas of dolomite character and the areas that are the contact zones of magmatic massifs and carbonate Triassic massifs. In these zones, the groundwater is relatively shallow, and accordingly, the forest systems of high mixed forests provide protection against pollution by suspended substances of source waters, which is likely to be caused by deep erosion and physical and chemical pollution transfers. In this way, a consistent quality of groundwater is ensured and maintained, while majority of possible polluters that could be contained in precipitated waters is kept on the above ground portions consequently mitigating the effects of incidental pollutions. In further process of adverse effects mitigation – in the processes of organic components disintegration, soil takes over an important role by transforming the possible polluters into stabile forms. The lower parts of the Vrba River sub-basin are mostly covered with deciduous forests, whose role of a protector against pollution is becoming increasingly larger during the vegetation season, while its role in protecting slopes against water-caused erosion processes is permanent.

The Middle Bosnia area, which is the *Bosna River sub-basin*, is susceptible to erosion processes and therefore, all types of the forest systems present, from this point of view, have an important role. Particularly important aspect is the one related to the lowest and hilly zones of the river sub-basin. The role of the dominant deciduous forests is important in this part of the river sub-basin, especially in the land slide zones. These forests, through their mechanisms, enhance the terrain stabilization processes or contribute to their deceleration. In this way, the established consistent dynamics of groundwater is maintained and the relative equalization of source yield is provided. The role of counter-erosion protection is significant and it is particularly evident during the vegetation season when there are intensive summer precipitations causing large damage. The high mixed forests, in the mountain zones within this river sub-basin maintain high quality of underground aquifers, preventing deep erosion and suppressing most of the physical and chemical polluters by their above ground and underground systems.

The mountainous zones of the *Drina river sub-basin* are covered with high mixed forests which have an important role in the protection of underground aquifers against incidental pollutions caused by deep erosion in karstified areas. The hilly zones are covered with deciduous forests with significant counter-erosion role and the role of equalizing the temperature fluctuations and the water drainage dynamics.

In the *Neretva River basin* the vegetation is highly diversified. In the source areas, the role of high mixed and deciduous forests - most of which are beech forests, in water protection is highly important. The importance of these forests is reflected in the protection of wider source area against incidental pollutions. In the canyonous and gorge-like areas, the forests have an important role in protection against water erosion. The karstified, mostly Jurassic and Cretaceous areas of the Neretva River basin are rich with underground watercourses and underground aquifers of different yield potentials, where all forest species and all forest community types play an important role in water protection against incidental pollutions or muddiness. The role of forest systems, mostly xerophytes, in the area of Herzegovina, where intensive and abundant precipitations are present causing strong deep and surface erosions is very significant. In the zones without forest vegetation, in the karstified areas, there is an extreme presence of surface and deep soil erosion, and as a consequence of such erosion, there are large areas of so-called exposed bare karst (Bos. „*ljuti*“ *krš*), being the areas where there are no surface watercourses at all. In the wider area of the Neretva River mouth, whose smaller portion is situated on the territory of Bosnia and Herzegovina, there is Hutovo Blato swamp that has multi-dimensional importance in terms of water protection, and the most important dimension is the diversity of flora and fauna, which is also defined in the European Directives.

In the *Krka and Cetina river basin*, deciduous forests are prevail, having an important ecological, environmental and water protection role. For the purpose of protecting underground karst aquifers, maintenance and enhancement of the forest systems are a must in order to minimize the possibility of pollution of the waters, as well as the numerous groundwater and the combined surface and ground watercourses. The standalone forest areas, at the periphery of karst *poljes* have an important role in minimizing adverse effects of eolic erosion and heavy evaporation of retention waters from agricultural land caused by warm winds.

The *Seaboard Area* is in its entirety karst area with no surface watercourses, where the presence of deep erosion and wind-caused erosion is very high. The degraded deciduous forest vegetation, mostly macchia and holly oak, has an important role in protecting underground aquifers and groundwater against muddiness and incidental pollution that might be caused by precipitations. This type of vegetation, although not representing a typical forest system, also have an important role in conservation of the water present in soil or close to the land surface and it is crucial in preserving the vegetation in the Mediterranean zone of the seaboard area. In addition to the above-stated, the seaboard area vegetation significantly mitigates the extreme temperature fluctuations during summer season, which again, creates conditions for an extended period of retaining available water volumes.

1.2.3.2. Forest Management in the Context of Protection against Erosions

Very unbalanced geomorphologic structure of the terrain in the Federation of BiH is one of the reasons for potential and realistic soil erodibility. Regardless of whether it is a forest, an agricultural or other type of area, the risks of water erosions are high.

Tertiary sediments mostly cover the *immediate Sava River basin* and they are very susceptible to water-caused erosions, while the possibility of occurrence of muddy torrents is very high in the areas in which stabile forests systems have been destabilized. The immediate Sava River basin represents an erodible area with the strong tendency of sediment accumulation and decrease in flow capacities of the inflow river waters. Therefore, the flat areas are constantly flooded.

In the zones of the *Una River sub-basin with Korana and Glina Rivers*, the erosion risks are also present. The protection against erosion is conducted through proper forest management and by keeping the other ecosystems stable.

In the mountainous areas of the *Vrba River sub-basin*, there is a potential torrent hazard, and therefore the protection of this part of the sub-basin is carried out through forest management activities and regulation of the wider riverbed zones. In the hilly zone of the Vrba River sub-basin, the erosion occurrence would become more likely if the stable forest ecosystems would be destabilized. The efficient measures are the protection of forests against excessive logging and keeping the other ecosystems stable.

The *River Bosna sub-basin* is an area that is very susceptible to erosions and in the flat parts of the river stream, the processes of eroded material accumulation are present, causing a decrease in flow capacities in the riverbeds with all of its consequences. As an important measure for protection against erosions, the improvement of forest management along with the reduction of logging is recommended. In addition, it would be necessary to raise general environmental awareness and knowledge that would significantly contribute to the stabilization of the areas under risk.

In the *Drina River sub-basin*, there are risks of erosion in case that the already established balances of forest ecosystems would be destabilized. The best protection measures are implementation of the planned forest management activities.

In the *Neretva River basin*, torrent-caused erosions have high presence, particularly in the dolomite areas and in the water reservoir zones. The occurrence of accumulations in the water reservoirs decreases their total capacities. The most important measures against erosion include re-forestation, maintaining balance in the existing forest ecosystems, as well as reducing the risk of fire.

In the area of *Krka and Cetina river basin* and in the *seaboard area*, where there is a high presence of limestone, considerably karstified massifs, the processes of deep erosion are very intense. These processes may adversely affect the vegetation survival. The most important measures for protection against erosions in these areas include the protection against excess pasture, logging ban, re-forestation and proper silvicultural measures.

1.2.4. Protected Areas

All protected areas, in the context of nature protection, have particularly large biodiversity and one of the main notions in adopting the protection framework was the overall maintenance of the existing ecological balances and mitigation of adverse anthropogenic influences, for the purpose of protecting natural resources which also include surface water and groundwater.

In the Federation of BiH, the environmental management is under the competence of the Federation Ministry of Environment and Tourism and the Cantonal ministries. At the level of the State of Bosnia and Herzegovina, these competences fall under the Ministry of Foreign Trade and Economic relations. In addition to the environment promoters, the Federation Ministry of Agriculture, Water Management and Forestry, as well as the Cantonal ministries are involved in these processes.

The treatment of protected areas is set out in the Law on Nature Protection⁷, stipulating protection, preservation, renewal and sustainable management of the nature in the Federation of BiH. This Law includes both general and special measures for protection through the establishment of protected areas. The Federation of Bosnia and Herzegovina has competences over protected natural resources and national parks, while the competences of the Cantons include protected landscape areas and nature monuments⁸. Pursuant to the Law on Waters, the category of protected areas also includes water source protection zones (Section 3.5.5. of the Strategy).

The Law on Protection of Nature regulates this subject matter for the purpose of defining the terms and conditions of protection, preservation and sustainable utilization of nature areas, general protection measures for nature's and animal species and special nature protection measures, which is accomplished by proclaiming and establishing the protected areas. The Law on Protection of Nature sets out four (4) spatial categories of protected areas⁹:

Category 1 – nature protection areas: a protected area established for scientific purposes or for the purpose of wildlife protection;

Category 2 – national park: a protected area established for the purpose of ecosystem protection and recreation;

Category 3 – nature monument: a protected area established for the purpose of preservation of specific nature characteristics;

Category 4 – protected landscape area: a protected area established for the purpose of preservation of terrestrial landscape areas, coastal areas and recreation.

On the territory of the Federation of BiH, several protected areas have been established so far, and some of them are as follows:

- *Major part of Una River sub-basin* has been proclaimed for "the area of significance for the Federation of Bosnia and Herzegovina"¹⁰ and it has been put under protection under the Law on the National Park Una. The main objective of putting this area under protection has been to protect the Una River and to preserve calcareous sinter, water quality, flora and fauna and their diversities, as well as cultural monuments within the boundaries of the area and its immediate contact zone. "The area of significance for the Federation" covers 19,800 ha which falls under the category "national park"¹¹, and the area of 13,500 ha is to fall under the category of "strictly protected area", while 6,300 ha will be categorized as "the area of controlled development". In addition to the Una River, the following watercourses having karst characteristic are significant

⁷ Official Gazette of FBiH No. 33/03. According to this Law, Article 25, the protected areas are: (1) protected nature areas established for the scientific purposes or for the purpose of the protection of wildlife, (2) national parks established for the purpose of the ecosystem protection and recreation; (3) nature monuments established for the purpose of preservation of the specific natural characteristics and (4) protected landscape areas established for the purpose of preservation of terrestrial landscape areas, coastal areas and recreation.

⁸ For the purpose of protected area management, other provisions have been adopted as well, and the most important ones are: Rulebook on Conditions for Access to the Protected Areas (Official Gazette FBiH No. 69/06); Rulebook on Contents and Method of Maintaining the Registers of Protected Areas (Official Gazette FBiH No. 69/06); Rulebook on Contents and Method of Development of Protected Area Management Plan (Official Gazette FBiH No. 65/06); and Rulebook on New Measures for Research or Preservation in order to Prevent Significant Adverse Effects on Animal Species by Deliberate Trapping or Killing (Official Gazette FBiH No. 65/06). In addition to the above-mentioned pieces of legislation and other documents, the protected areas are also covered by the Law on Physical Planning and Land Use at the level of the Federation of Bosnia and Herzegovina (Official Gazette FBiH No. 02/06). This Law regulates the areas of special attributes, the areas of exceptional natural and cultural and historical significance.

⁹ The categories of the protected areas do not correspond to the categorisation of the International Union for Conservation of Nature, and this should be adjusted by adopting amendments to the Law on Nature Protection (Source: „Information on protected nature areas in Sarajevo Canton, Ministry of Physical Planning and Environmental Protection of Sarajevo Canton, November 2008).

¹⁰ Decision on Proclaiming the Una River basin for the Area of Relevance for the Federation of BiH, Official Gazette FBiH No. 32/04

¹¹ Law on the National Park Una, Official Gazette FBiH No. 44/08

and noteworthy: Unac, Ostrovica, Klokot and Bastašica, with their exceptionally beautiful wellsprings.

- The mountain chain Igman-Bjelašnica-Treskavica and Visočica have been proclaimed for *the special attributes areas of relevance for the Federation of Bosnia and Herzegovina*.¹² This area encompasses Herzegovina Neretva Canton and Sarajevo Canton, covering approximately 900 km². In this area of special attributes, the important watercourses are Željeznica, Bijela rijeka and Crna rijeka, and in the wider area, there is the River Neretva and the Boračko Lake with the River Šištica, as a watercourse outflowing from the lake and the River Rakitnica. There is barely any surface water in this entire area. The entire area is distinguished by an exceptional diversity in vegetation. The specific quality of this area is the virgin forest of „Ravna Vala“, which represents a special research and education reservation.
- *Nature monument Skakavac*, on the territory of Sarajevo Canton¹³, covering 1,430 ha. It is important from the hydrological point of view and distinguished by a high level of biodiversity.
- *Nature monument Vrelo Bosne*, on the territory of Sarajevo Canton, covering 603 ha.¹⁴
- *Nature monument Tajan*, on the territory of Zenica-Doboj Canton. This protected area covers 3,510 ha and it encompasses the Municipalities of Zavidovići and Kakanj.¹⁵
- *Nature monument Prokoško jezero*, on the territory of Middle Bosnia Canton, covering 2,225 ha.¹⁶
- *Protected landscape area Bijambare* covers the area of 367.36 ha and it is characterized by geomorphologic and vegetation specific qualities. The protected area „Bijambare“¹⁷ has been proclaimed for "protected landscape area" thus falling under category IV and the purpose of this area is preservation, scientific research, ecological education, as well as recreation and tourism.
- Recreational centre “Duga Luka” near Bihać has been proclaimed for the *protected area* of “special-purpose forests”, covering 118.2 ha.¹⁸

Two nature parks, established in 1995 have special relevance for the Federation of Bosnia and Herzegovina: Hutovo blato and Blidinje¹⁹. The Hutovo blato nature park is a swamp area in the Neretva River basin. This is one of the richest protected areas covering 7,411 ha and it has been included in the list of specially protected Mediterranean areas according to the 1964 Barcelona Convention. Hutovo blato is, currently, the only area in the Federation of BiH that has been included (in 2002) in the list of swamp habitats having international importance (1971 Ramsar Convention). The Blidinje nature park is situated in the area of mountain Čvrsnica, at approximately 2,000 m a.s.l. The flora in this part and the neighbouring areas of mountains Prenj, Čabulja and Vran, being the group of mountains that phytogeographically fall under the so-called

¹² Decision on Proclaiming Igman, Bjelašnica, Treskavica and the River Rakitnica Canyon (Visočica) for the area of special attributes that is of relevance for the Federation of BiH, Official Gazette FBiH No. 8/85

¹³ Decision on Proclaiming the wider area of the waterfalls Skakavac for the nature monument, Official Gazette of Sarajevo Canton No. 10/02

¹⁴ Law on Proclaiming Vrelo Bosne for the nature monument, Official Gazette of Sarajevo Canton No. 16/06

¹⁵ Official Gazette of Zenica-Doboj Canton No. 3/08

¹⁶ Official Gazette of Middle Bosnia Canton, No. 12/05. The initiative to proclaim the Semešnica zone for nature monument has been instigated.

¹⁷ Law on Proclaiming the protected landscape area, Official Gazette of the Sarajevo Canton No. 21/03

¹⁸ Decision on Proclaiming of the Special-Purpose Forest, with the official name: Recreational Centre Duga Luka Plješevica, Bihać, Una-Sana Canton, Cantonal Ministry of Agriculture, Water Management and Forestry, 3 May 2006.

¹⁹ Provision on Nature Protection HR HB, Law No. 13/95

“Herzegovinian Endemic Development Centre”, are rich with endemic species existing only in these mountains or in the Dinarides zone.

The total of 280.76 km²²⁰ was protected in the Federation BiH up to 2009 in compliance with the Law on Environmental Protection. Protected areas prior to adoption of the Law on Environmental Protection amount to 435.49 km², making thus the total protected area of 716.25 km², or 2.74% of the Federation BiH, or 1.4% of the area of Bosnia and Herzegovina.

1.2.5. General Hydrographic Characteristics

Hydrographically, surface waters of the Federation of BiH belong to River Basins of Black or Adriatic Sea. Out of the total territory of the Federation of BiH (26,127 km²), 17,506 km² (67%) belongs to the River Basin of Black Sea, i.e. the Sava River Basin District, while 8,621 km² (33%) belongs to River Basin of the Adriatic Sea basin, i.e. the River Basin District of the Adriatic Sea.²¹ The division of the territory of the Federation of BiH by the above-mentioned river basin districts makes also the basis for the territorial competences of the water agencies that have been established in accordance with the Law on Waters. The figure below presents an illustrative overview of the river basin districts.

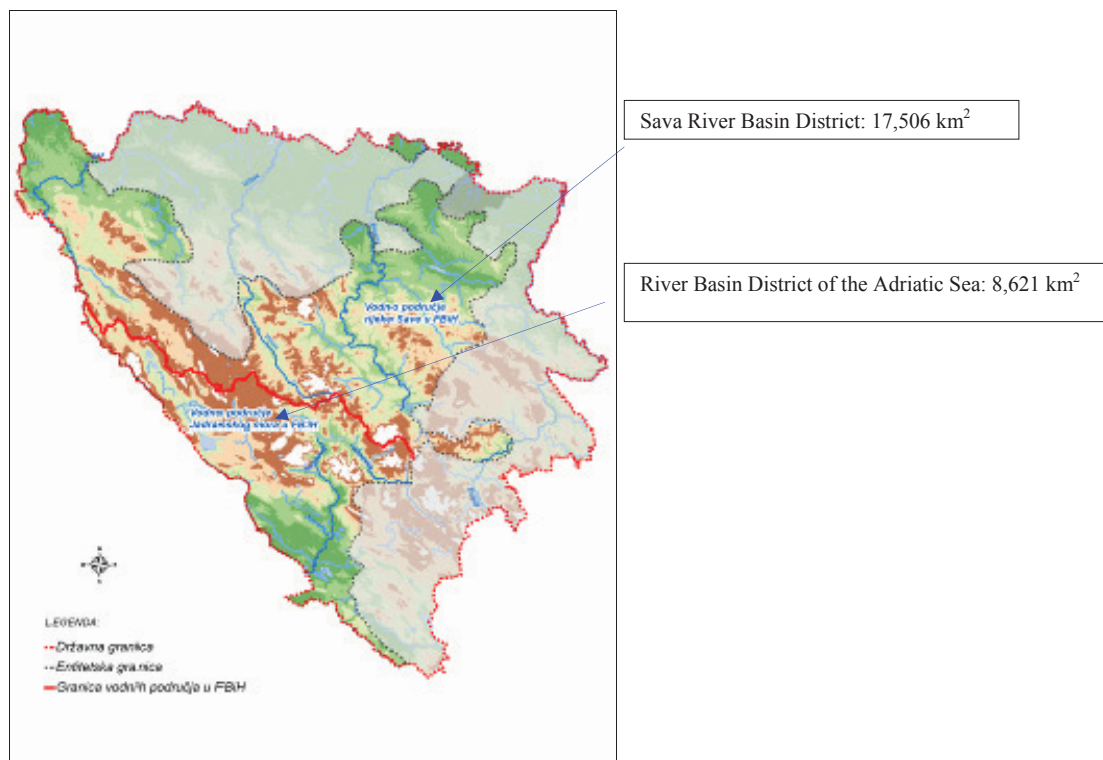


Figure 1.2.3: Boundaries of the river basin districts in the Federation of BiH

¹ Based on information from the Federal Ministry of Environment and Tourism, April 2010..

²¹ „Decision on the Boundaries of the River Basins and the River Basin Districts on the territory of the Federation of Bosnia and Herzegovina“, Official Gazette FBiH No. 41/07

The information set out in this Decision is different from the information available at the Federal Hydrometeorological Institute Sarajevo. According to this institution, the size of the Sava River Basin District is 17,533 km².

The following figures show the areas of analysis that are followed by the main hydro-geological and hydrographical characteristics of the river basins and sub-basins in the Federation of BiH.

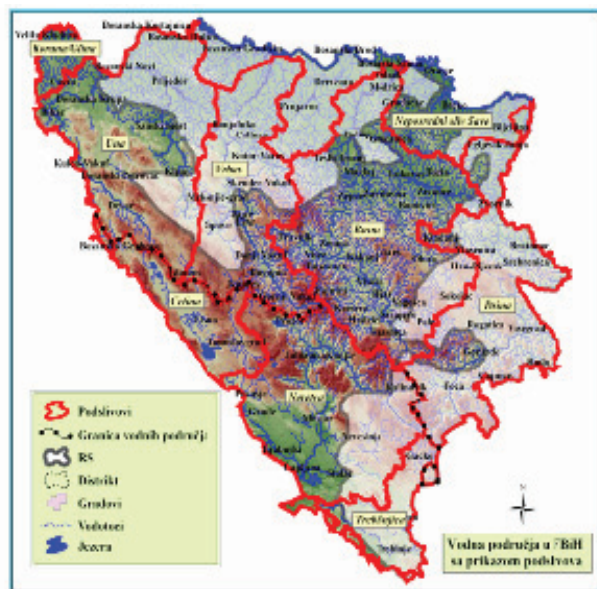


Figure 1.2.4: River basin districts in the Federation of BiH with river basins and sub-basins

1.2.5.1. Sava River Basin District

- *Immediate Sava River basin.* The entire area of the Sava River sub-basin in Bosnia and Herzegovina is pleographically located between the Pannonian valley and the central Dinaridic area. The development of the Sava River valley is associated with the development of the Pannonian Basin originating in Middle Tertiary Era. The Sava River sub-basin area in the Federation of BiH is limited to 1,155 km²²² and it mostly covers the Tinja River sub-basin.

²² The source of data related to the sizes of individual sub-basins and river basins is the Federal Hydrometeorological Institute, Sarajevo. The discrepancies with respect to the Decision on the Boundaries of the River Basins and the River Basin Districts on the territory of the Federation of Bosnia and Herzegovina", Official Gazette FBiH No. 41/07 are the consequence of different work methodologies, which is the subject of the future joint work of the above-mentioned institution and the River Basin District Agencies for the Sava River and the Adriatic Sea.



Figure 1.2.5: Immediate Sava River Basin

- *Una River sub-basin with the rivers Glinu and Korana*: Una River drains the western side of Dinaridic karst and its sub-basin in the Federation of BiH covers 5,762 km² (Una River with Sana River), and in total, it covers 9,368 km². The Una River source is composed of a large number of significant karst wellsprings. In addition to the main one, to the south of Suvaja River, there are another two - Velika Netka and Mala Netka. These three wellsprings form Una River that downstream directly receives the water of Srebrenica. The major right confluent of the Una River are: Unac, Krušnica, Sana, Mlječanica and Moštanica. Its left confluent are Klokot and Žirovac. Una River has a characteristic regimen of precipitation and snowfalls, with low summer and high spring and autumn flow rates, and very often, exceptionally high winter flood water levels.



Figure 1.2.6: Una River sub-basin with rivers Una and Korana

- *Vrba River sub-basin.* This area is situated in the south-west part of the Federation of BiH, i.e. in the central part of Dinaridic massifs. The total size of the river basin is 6,386 km², while in the Federation of BiH, it covers 2,165 km². The Vrba River source is situated at the foot of the mountain Vranica. Its major right confluences are Ugar and Vrbanja, while the left ones are Pliva and Crna Rijeka. Vrba River has an intensive pluvial snowfall regimen with high spring and autumn and low winter and summer flow rates.



Figure 1.2.7: Vrba River sub-basin

- *Bosna River sub-basin:* This sub-basin area is situated in the central part of the Federation of BiH. The total size of the river basin is 10,457 km², out of which 7,477 km² is situated in the Federation of BiH. The Bosna River is formed from a strong karst wellspring located at the foot of the Mountain Igman. Its major right confluences are Željeznica, Miljacka, Stavnja, Krivaja and Spreča, while the left ones are Zujevina, Fojnica, Lašva and Usora. The river Bosna sub-basin is the area with the highest population density in the Federation of Bosnia and Herzegovina having the most important industrial capacities.



Figure 1.2.8: Bosna River sub-basin

- *Drina River sub-basin.* The entire Drina River sub-basin is situated in the central part of Dinarides, emerging with its smaller part in Albania and continuing all the way to Panonnian valley i.e. to the Sava River mouth. The total size of the sub-basin is 19,946 km², out of which 974 km² is located in the Federation of Bosnia and Herzegovina. The Drina River is formed by confluence of the Piva and Tara rivers, and its right confluences located upstream of the river mouth are Čehotina, Lim, Uvac, Rzav and Jadar, while the left ones are Sutjeska, Prača and Drinjača. In water regimen of this river, high spring flow rates are dominant as a result of snow melting and intensive precipitation. Low summer flow rates are particularly recurrent, as a result of scarce precipitations and rather intensive evapotranspiration.

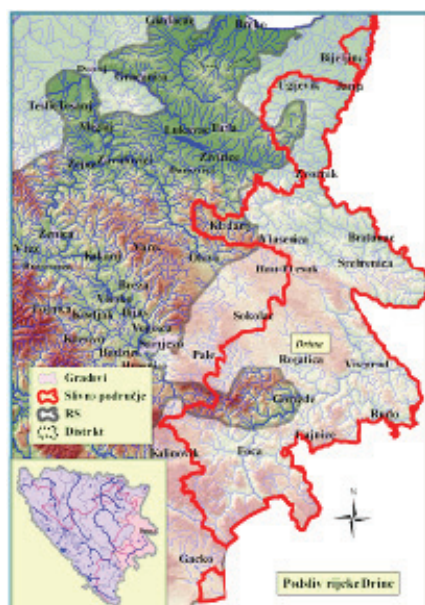


Figure 1.2.9: Drina River sub-basin

1.2.5.2. Adriatic River Basin District

This area in the Federation of BiH encompasses excessive karst zone where the following major surface watercourses have been formed: Neretva, Krka and Cetina. This area is mainly composed of permeable rocks of calcified limestone of Mesozoic and Cainozoic, while the presence of impermeable rock masses is sporadic. The spring well forming in such areas is the result of the karst ability to converge courses of groundwater circulations draining on one or several locations. The impermeable sediments present in cavernous-fracture collectors cause the accumulated water to effuse to the surface over the barriers. Large karst spring wells are commonly linked to the lowest erosive basis, although they can be found at higher horizons. The groundwater circulation in karst areas differs from the groundwater circulation in other environments and it is difficult to determine the exact circumstances under which such circulation occurs. The following watercourses, i.e. river basins are of relevance for the Federation of BiH: the Neretva River basin and the Krka River basin with the Cetina River.

- *Neretva River basin.* It covers most of the Adriatic River Basin District, and being 205.12 km long in total in BiH, it makes the largest river of BiH karst. The size of the river basin located in the Federation of BiH is 5,745 km², while the total size of the river basin is approximately 12,750 km², including the Trebišnjica River sub-basin. In its upper course, Neretva flows through a canyon and receives the following right confluences: Jasenica, Rakitnica, Trešanica, Kraljušnica, Neretvica and Rama, while its left confluences are Šištica and Bištica. In the middle course, downstream of the City of Jablanica, it receives its right confluences Doljanka and Drežanka and its left confluence Prenjska rijeka. In its lower course, downstream of Mostar, Neretva forms a wide valley and receives its right confluences: Radobolja, Lištica and Ugrovača, flowing through Mostarsko Blato and Jasenice, while downstream of Čapljina, it receives the river Trebižat. Its left confluences in this area are Buna, Bregava and Krupa. In spite of the fact that Neretva is rich with water, its confluences coming from higher horizons occasionally desiccate. A part of its left confluence in the Federation of BiH – the Trebišnjica River, is directed to the Hydro Power Plant Čapljina, through partially regulated riverbed in Popovo polje.

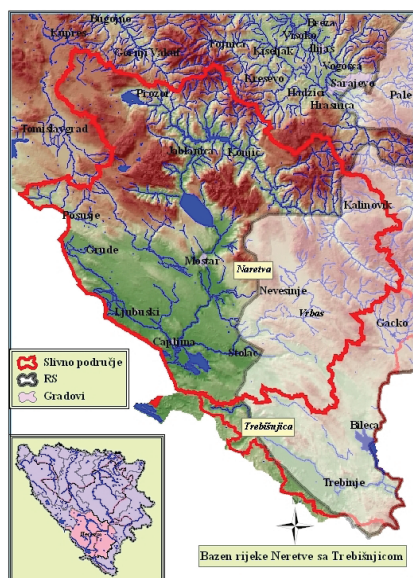


Figure 1.2.10: Neretva River basin with Trebišnjica

- *Krka and Cetina River basin.* This area, being 2,876 km² in size, encompasses karst *poljes* of the western part of the Federation of BiH – Glamočko polje, Livanjsko polje, Kupreško polje and Duvanjsko polje – whose altitude vary from 700 to 1,200 meters above sea level. The differences in height, karstified permeable limestone and impermeable tertiary sediments in karst *poljes* create vigorous spring wells, such as Bistrica, Sturba, Žabljak and Šuica. The watercourses flowing from these spring wells are mostly short; they have no surface recipients, but disappear underground through sinkholes flowing into the River Cetina. After establishment of the Hydro Power Plant Orlovac, the water of West Bosnia karst *poljes* is mostly collected in the accumulation facility Buško blato, and from there, after being exploited in the Republic of Croatia, it is discharged into the River Cetina.



Figure 1.2.11: Krka and Cetina Rivers Basin

The following chart shows the ratio of the described river basins and sub-basins in the Federation of BiH.

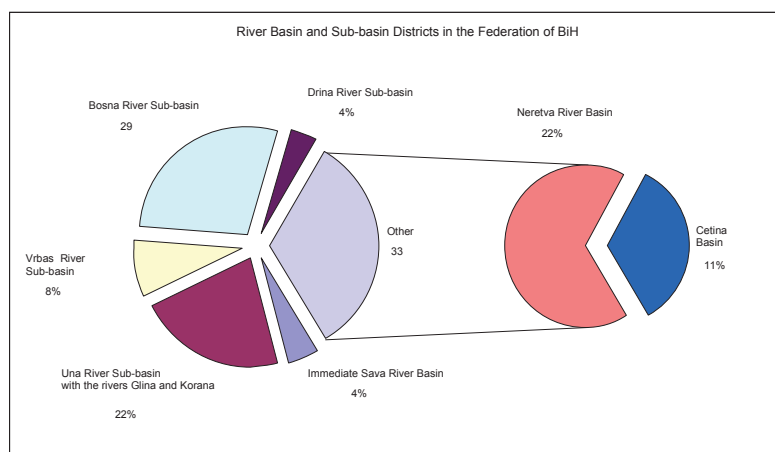


Figure 1.2.12: River Basin and Sub-basin ratio in the Federation of BiH

One of the characteristics of the Adriatic River Basin District is karst *poljes* that are formed in chains at different altitudes. This sort of position enables cyclic appearance and disappearance of water from *polje* to *polje*, i.e. it enables the water from higher horizon spring wells, entirely or partially to appear at the lower horizon spring wells. The karst *polje* chain in the south-west part of the Federation of BiH stretches from Kupreško *polje*, having average altitude of approximately 1,150 m a.s.l., to Jezerce, having average altitude of 30-36 m a.s.l. This chain includes: Glamočko *polje* and Duvanjsko *polje*, Livanjsko *polje* with Buško blato, Posuško *polje* and Virsko *polje*, Imotsko-bekijsko *polje*, Mostarsko blato, Ljubuško *polje* and Rastok. In addition to these, there are smaller karst *poljes*, such as Raško *polje* and Rakitno *polje*. All of these karst *poljes* make part of Dinaridic karst, and therefore, their bearing mostly corresponds to the bearing of Dinaridic massif: northwest – southeast. For most of these *poljes*, the positions of spring wells are also specific, i.e. the water inflows are usually located at northeast boundaries, while the outflow zones, being the endings of watercourses or sinkholes are situated along the southwest boundaries. The table below shows the basic data related to the position and size of some of the karst *poljes* in the Federation of BiH.

Karst <i>polje</i>	Size	Length	Width	Altitude
	(km ²)	(km)	(km)	(m a.s.l.)
Livanjsko	365	65	6	705-710
Duvanjsko	126.1	20	7	860-930
Glamočko	130			880-900
Kupreško	152.7			1,150
Posuško	15.2	21	0.5-0.2	570-600
Bekijsko	51	35	1-6.0	250-270
Tihaljina-Mlade-Trebižat	57	20	0.5-0.3	75-130
Mostarsko blato	33.6	125	2.8	225-250

Table 1.2.2.: Basic characteristics of larger karst *poljes* in the Federation of BiH ²³

²³ Added to that figure should be a part of the largest karst *polje* in Bosnia and Herzegovina, Popovo *polje*, which belongs to the Federation BiH, covering 20.15 km² with average altitude ranging from 220 to 240 m a.s.l.

1.2.6. Relief

Bosnia and Herzegovina, as well as the Federation of Bosnia and Herzegovina are dominantly mountainous with flat areas situated along larger river banks. Following the direction from North to South, the flat part gradually turns into wide foothills sloping upward from 200 to 600 m a.s.l., progressively turning into a mountainous region. The remaining part of the region is covered with Dinaric Mountains with northwest-southeast bearing. The central part is dominated by mounts composed of noncarbonated rocks, amongst which the following river basins and valleys are situated being proportionally wide – the Sarajevo-Zenica valley and the Tuzla valley. The southwest area is composed of Jurassic and limestone rocks. In the karst zone of Dinarides, at different altitudes, there are karst *poljes*. The hilly eastern area is mostly composed of impermeable rocks. The southern part of the region sloping downwards in cascades to the Adriatic Sea is mostly composed of cretaceous and Jurassic limestone. The upper part is made of Dinaric mountain chains, with karst *poljes* stretched amongst them, while the lower parts are dominated by plateaus, also with karst *poljes* (Ljubuško polje and Mostarsko polje).

Generally speaking, the area of the Federation of BiH belongs to the category of medium-sized mountain relief, and the basic hypsometric characteristics of the terrain are shown in the following chart:

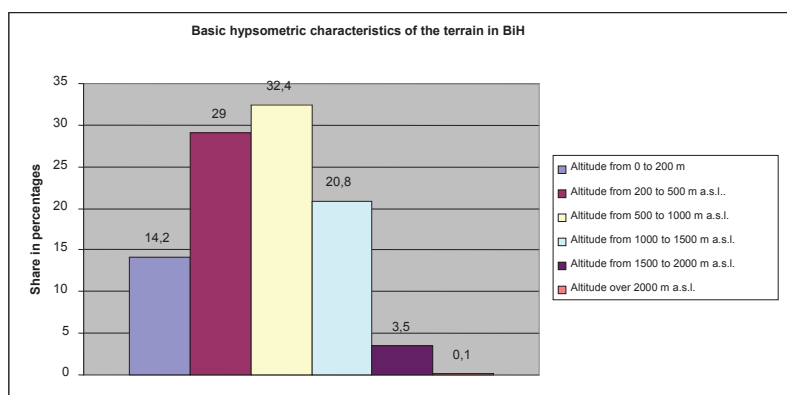


Figure 1.2.13: Basic hypsometric characteristics of the terrain in BiH

It would be important to mention that the largest vertical faults are located around watersheds of the Sava River Basin District and the Adriatic River Basin District, while the degree of horizontal faulting is the lowest on the limestone-dolomite substrates. The steepest slopes of the terrain are at gorges and at the transitions to high ridges, while the least steep ones are at the basins and intermountain depressions.

1.2.7. Climate

The climate features are caused by geographical position of the Federation of BiH, the proximity of the Adriatic Sea, the mountain chains bearing, and the constant swap of air masses originating from the Atlantic Ocean, Mediterranean Sea and continental part of Europe. The climate of one area represents a natural framework for placing and adapting life activities and thus, the water management system, as well. The region of Bosnia and Herzegovina is specific by its dynamic

changes in climate features on a relatively small area. On the stretch of about 200 km, from the Adriatic Sea towards the inland, there are three climate zones.

With respect to latitude, Bosnia and Herzegovina, together with the Federation of Bosnia and Herzegovina is located in the North Temperate Zone, meaning that this position determines its general climate without dominance of only one climate type. According to the specific climate features, there are three separate zones:

- *Maritime zone*, mainly in the region of Herzegovina, with modified Mediterranean, i.e. maritime climate. The main features of this climate include mild winters and sporadically high summer temperatures. The mildest climate within this zone is in the Neretva river basin, in its middle and lower course. The annual precipitation volume ranges between 1,000 and 1,500 l/m² distributed throughout the year, being the least intensive in July and August (only 30 l/m²), and the most intensive during spring and autumn, with over 150 l/m² at average.
- *Alpine zone*, covering the Central Bosnia region with continental mountain climate. The main features of this climate are cold winters, with temperatures going down to – 30⁰C. The average annual precipitation volume ranges from 1,000 to 1,200 l/m². The most intense precipitations are in late autumn (94 l/m²), while the least intense precipitations are recorded in February (around 67 l/m²). Snowfalls are heavy, particularly at higher altitudes.
- *Temperate climate zone*, cover northern parts with Central European climate, fairly cold winters and warm summer months. The Posavina region is the warmest, with July temperatures of around 21⁰C; however, this zone is the scarcest in precipitation, having annual precipitation volume of 700 to 800 l/m². Slightly warmer areas are situated in the Una and Sana river basins, with July temperature of around 22⁰C and annual precipitation volume of around 1,000 l/m². Cooler zones are at middle courses of the rivers Bosna and Vrbas, where July temperatures fluctuate around 19⁰C, with annual precipitation volume of 800 to 1,200 l/m².

The precipitation and temperature regimes are shown in the form of annual variability within 30 years period of time (1961-1991), in the following tables and charts.

Area	Monthly mean temperature(C)												Mean T.(C)
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Bosna river sub-basin	-0,83	1,73	5,57	10,13	14,63	17,50	19,30	18,87	15,40	10,60	5,40	0,57	9,9
Immediate Sava river basin	-0,70	2,10	6,70	11,90	17,10	19,90	21,40	20,80	17,20	11,70	6,60	1,50	11,3
Drina river sub-basin	-1,20	1,70	5,70	9,70	14,40	17,30	19,00	18,60	15,30	10,30	4,90	0,40	9,7
Una river sub-basin	0,10	2,15	5,90	10,10	14,85	17,90	19,65	19,05	16,00	11,15	7,40	1,80	10,5
Vrbas river sub-basin	-1,25	1,20	4,95	9,45	13,90	16,80	18,60	18,15	14,80	10,15	5,10	0,20	9,35
Neretva river basin	2,27	4,33	7,70	11,90	16,37	19,63	21,77	21,37	17,97	12,90	8,07	3,73	12,67
Cetina river basin	-2,53	-1,40	3,03	6,20	11,47	14,37	16,53	16,30	12,87	8,63	3,47	-0,97	7,33

Table 1.2.3.: Monthly mean air temperatures by river (sub-) basin in the Federation of BiH

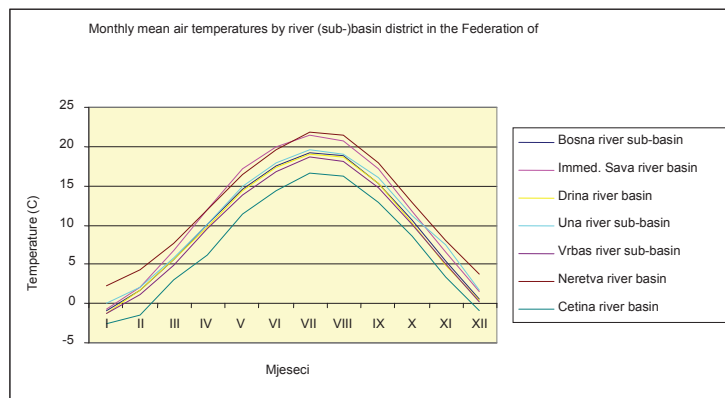


Figure 1.2.14: Monthly mean air temperatures by river (sub-) basin in the Federation of BiH

The following table and chart show the monthly and annual mean precipitation values for the period between 1961 and 1991, by river (sub-) basin.

Area	Average monthly (l/m2)												Av. annu al. (l/m2)
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Bosna R. sub- basin	60,333	56,667	61,667	70,667	82,667	95	78,333	74,667	66,333	66,667	79,667	74,667	867,33
Immed. Sava R. basin	47	49	51	64	71	84	65	65	50	46	64	64	720
Drina R. sub- basin	55	52	51	67	68	80	63	69	68	68	86	71	798
Una R. sub- basin	74	73,667	83	99,667	102,67	109,33	101,33	96	93,333	91,333	114,33	94,333	1133
Vrbas R. sub- basin	55,5	58,5	63,5	67	79,5	86,5	72,5	71,5	73	71	93	79,5	871
Neretva R. basin	154,33	163	157	132	102,33	86,667	51,333	82,667	109	160	286,67	193	1528
Cetina R. basin	104,33	100,33	100,67	103	88	95	70	75,667	93,333	118	157,67	147,33	1193,33

Table 1.2.4.: Monthly mean precipitation values by river (sub-) basin in the Federation of BiH

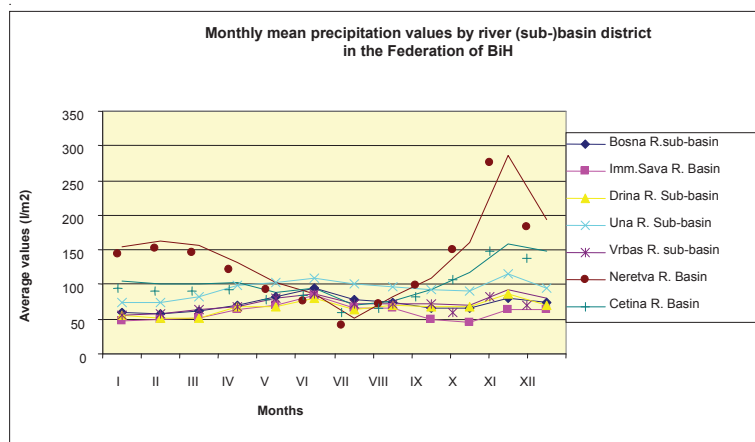


Figure 1.2.15: Monthly mean precipitation values by river (sub-) basin in the Federation of BiH

The spacial distribution of the average annual precipitation (in mm) for the region of the Federation of Bosnia and Herzegovina is shown on the map below – isohyets map.

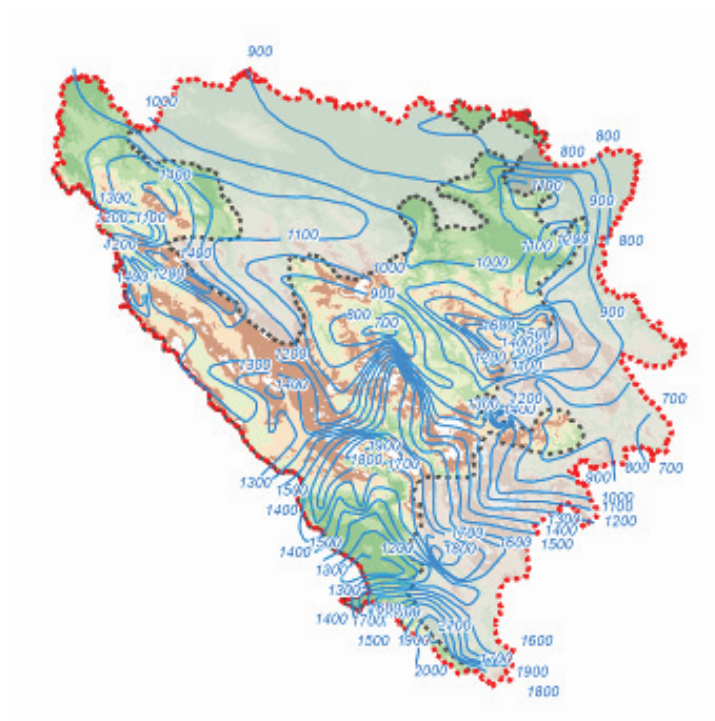


Figure 1.2.16: Distribution of isohyets for the region of the Federation of BiH

2. Water Status

2.1. Surface waters

2.1.1. General quantitative characteristics

Mean annual precipitation for the whole of Bosnia and Herzegovina amounts to 1250 l/m². With the land area of 51,197 km² the total volume of storm water is about 64x10⁹ m³, i.e. the corresponding total runoff is 2.030 m³/s. The average inland runoff from Bosnia and Herzegovina is 1.200 m³/s, and the average runoff coefficient is 0.57. Water is discharged from the area of 38,719 km² (75.7%) in the direction of the Danube river basin and from 12,410 km² (24.3%) in the direction of the Adriatic Sea basin. Out of the total water quantities, 722 m³/s are discharged in the direction of the Danube river basin and 433 m³/s in the direction of the Adriatic Sea basin. Characteristic indicators per individual sub-basins and river basins in Bosnia and Herzegovina are given in the following table.

River basin/Sub-basin	Area of river basin/sub-basin in B-H	Water-courses longer than 10 km	Specific average flow q
	(km ²)	(km)	(l/s/km ²)
Immediate Sava river basin	5,287	1,693.2	11.4
Sub-basin of the r. Una	8,143	1,480.7	26.1
Sub-basin of the r. Vrbas	6,274	1,096.3	19.9
Sub-basin of the r. Bosna	10,810	2,321.9	16
Sub-basin of the r. Drina	7,119	1,355.6	21.2
<i>Total Danube r. basin</i>	<i>37,633</i>	<i>7,947.7</i>	
Neretva and Trebišnjica river basin	7,912 + 2,021	886.8	38.1 + 49.4
Krka and Cetina river basin	83 + 2,633	177	34.6
<i>Total Adriatic Sea basin</i>	<i>12,649</i>	<i>1,067.8</i>	
TOTAL B-H	50,282	9,011.5	

Table 2.1.1: Characteristic indicators of river basins and sub-basins in BiH²⁴

The region of the Federation BiH is characterized by similar hydrologic flow conditions. Out of total area, 17,506 km² (67%) belong to the Danube river basin, or the Sava river basin district and 8,621 km² or 33% of the territory to the Adriatic Sea river basin district. So, out of total water quantities, 353 m³/s (inland average annual runoff) are discharged from the Federation BiH in the direction of the Danube river basin and 317 m³/s in the direction of the Adriatic Sea basin, giving thus the total inland runoff of 670 m³/s from this area. For average precipitation quantity of 1,250 l/m² and corresponding total runoff of 1,037 m³/s, the average runoff coefficient is 0.65.

²⁴ Source: Draft water management plan of BiH. JVP Vodoprivreda BiH, Zavod za vodoprivredu Sarajevo, Sarajevo 1994.

2.1.2. Spatial and time distribution

From the above framework data it is possible to notice, as already seen in many previous studies, the discrepancy between available water quantities and dynamics of needs. The parts of the Federation BiH that are the poorest in their inland waters are at the same time the parts with the most pronounced needs – a part of Posavina with agricultural potentials and the area of the sub-basin of the river Bosna with the highest population density and industrial potentials. Low water periods, expressed through minimum average monthly flows with 95% probability last relatively long (June-September) usually in periods of the most pronounced needs for water (requirements by inhabitants, agriculture and unfortunately, still existing, needs for water for pollution dilution.). Considering population density per analyzed regions, the picture of spatial and time distribution of available water quantities is even more unfavourable. According to estimates, about 1,340,000 inhabitants or 57% of the total population of the Federation BiH live in the area of the river Bosna sub-basin. At the same time, this area covers only 19.8% of the inland flow in the Federation BiH. In terms of water quality, the situation is also unfavourable. The most densely populated areas are also the most distinct polluters of available waters that for the time being are still mostly without developed systems of quality protection, which is a limiting factor for downstream users. Slightly more favourable situation is in the Adriatic Sea RBD. It covers 33.3% of the total area of the Federation BiH, with estimated population of 16% and 47% of inland flows of waters of considerably better quality than in other regions.

Low waters in river basins and sub-basins of the Federation BiH are very pronounced. The values of minimum mean monthly waters with 95% probability amount up to 15% of mean annual flows. These values are mostly dealt with when talking about minimum waters that preserve survival of ecosystems in and around waters. The sub-system of the river Bosna is in the worst situation in that respect. About 13% of the minimum flows of the Sava river are discharged from this sub-basin. A very unfavourable relationship is present in the whole of the Sava river basin, expressed by: $\min Q_{\text{monthly}, 95\%} = 0.15 Q_{\text{aver.yr}}$. A similar situation is noticed in watercourses of the Adriatic Sea basin district, with very non-uniform flow regime.

High waters occur in the Federation BiH in the form of torrential regimes, with short floods and large runoff modules ($1-1.5 \text{ m}^3/\text{s}/\text{km}^2$). For the Sava river basin district, average proportion between mean annual flows and high waters of the occurrence probability of 1% amounts to $Q_{(1\%)} = 18.5 Q_{\text{aver.yr}}$. It means that this river basin district with the highest population density and highest water requirements is unfavourable in view of both low and high water regimes.

Natural lakes: There are several natural lakes in Bosnia and Herzegovina of various types and with various hydrological characteristics. Some of them are perennial and some are intermittent. The first group covers:

- *River lakes*, i.e. “running waters lakes”, made in widening of a river channel or due to a backwater caused by natural barriers in the riverbed. There are but of few of them in the territory of the Federation BiH, mostly in the rivers Pliva, Una and Trebižat. They are not important either in relation to water sector or in terms of hydrology, except for some slight impact on decrease of peak levels of high waters. On the other hand, these lakes are highly valued as beauty spots and ecological factors. This kind of perennial lakes in Bihar not been studied to a great extent. The exception is investigation of genesis and existence of (most often) travertine barriers and some morphological measurements (at

the lake on the Pliva). There used to be similar lakes along the middle reach of the river Neretva (Svitava, Derani, etc) prior to the construction of water power structures.

- *Mountainous lakes* are scattered over a part of the Dinarides belonging to BiH, and are most often of glacial origin. According to an estimate there are about 30 of them in the whole of BiH, although all of them have not been defined adequately. Except for Boračko jezero, all of them are with maximum volume less than $1 \times 10^6 \text{ m}^3$ and thus of small hydrologic significance. In terms of ecology (and scenery) they are locally important. Water quality in them is mainly satisfactory, although some of them show eutrophication symptoms (e.g. Boračko jezero).
- *Intermittent lakes* are the ones which occur as retention basins in some karst fields during rainy periods of the year or after snow melting. The most important ones are in the Adriatic Sea RBD, although there are some (but fewer and less important) in the Sava RBD (Podraščica, Lušci, Palanka, etc). Intermittent retention ponds existed in terrain depressions along the riparian part of the Sava river at several locations in Bosanska posavina prior to implementation of flood control structures.

2.1.3. Surface water quantities

Review of surface water quantities for the Federation BiH has been made on the basis of hydrologic parameters per basic river basins and sub-basins. Mostly used was the period of hydrologic stations work from 1961 to 1990. (According to the World Meteorological Organization /WMO/ the series of data are adequate enough for carrying out hydrological analyses).

2.1.3.1. The Sava RBD

The Una river sub-basin:

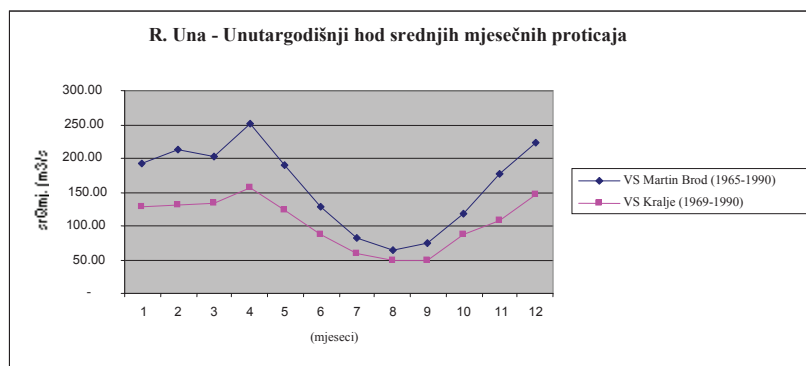
The river Una springs in the Republic of Croatia and after some kilometres comes to Bosnia and Herzegovina, i.e. the Federation BiH near the place called Martin Brod. There, it receives its right tributary Unac with water flow quantities approximately the same as the ones of the river Una at the confluence.

The river Sana, the largest tributary of the Una, has both its source and its mouth in the Republic of Srpska, in Bosanski Novi (New Town). The Una river sub-basin (with its tributary Sana) covers $5,020 \text{ km}^2$ in the Federation BiH.

The Una river in the region of FBiH has been hydrologically well investigated, thanks to a considerable number of hydrological stations in the basin at which systematic registration of water levels and measurements of flow have been carried out over many years (locations of hydrologic stations are given in the graph below in the text). What characterizes the river Una along practically all of its sub-basin area that belongs to the Federation B-H is the impact of karst, with all of its immanent features. The main consequence of that impact is not so well developed hydrography on the surface on the one hand, and the existence of a considerable number of strong karst springs with good quality water characteristics on the other hand. This refers, first of all, to the spring Klokot (Bihać-Una); springs Dabar, Zdena, Sanica (all in the river Sana sub-basin), and of course, the springs of the Una and the Sana rivers. Deterministic influences in the Una river sub-basin are not significant; it is simply a stochastic flow process. Noticeable is only the Hydro Power Plant Kostela on the river Una (downstream of Bihać), but, as this is a run-in-the-river hydro

power plant, there is no significant impact on natural flow regime. There is also an “old” dam in the upper reach of the river Unac.

The flow regime, described above in the text, has been quantitatively numerically defined in the table below and shown in the map of hydrography of the river basin with all characteristic locations.



Characteristic values of flow at hydrologic stations of the Una river sub-basin are given in the table below in the text, with graphic presentation of intra-annual rate of average monthly flows.

VS (Water gauging station)	Stream	Q _{av.yr} (m ³ /s)	av. Q _{min} (m ³ /s)	max Q _{1/T} (m ³ /s)		
				20 yrs	50 yrs	100 yrs
Martin Brod – upstr.	Una	23.5	4.97			
Drvar	Unac	7.7	0.5			213
Rmanj Monastery	Unac	29.5	5.6			
Martin Brod – downstr.	Una	53.5	10.6	492	543	588
Kulen Vakuf	Una	53.6	10.9			
Bihać	Una	90	23.4	780	875	933
Klokot	Klokot	14	4.4			
Kralje	Una	104	27.8			
Bosanska Krupa	Una	116	29.5			
Ključ	Sana	35.5	6.53	290	341	386
Vrhopolje	Sana	42.8	8.48	429		535
Sanski Most	Zdena	1.08	0.24	Max regist. 7.83		
Hrustovo	Sanica	14.9	1	262		
Dabar	Dabar	5.5	0.41			
Sanski Most	Sana	68.9	11	560	675	771
Pobriježje	Bliha	2.92	0.22			

Table 2.1.2: The Una river sub-basin: characteristic flow values at hydrologic stations

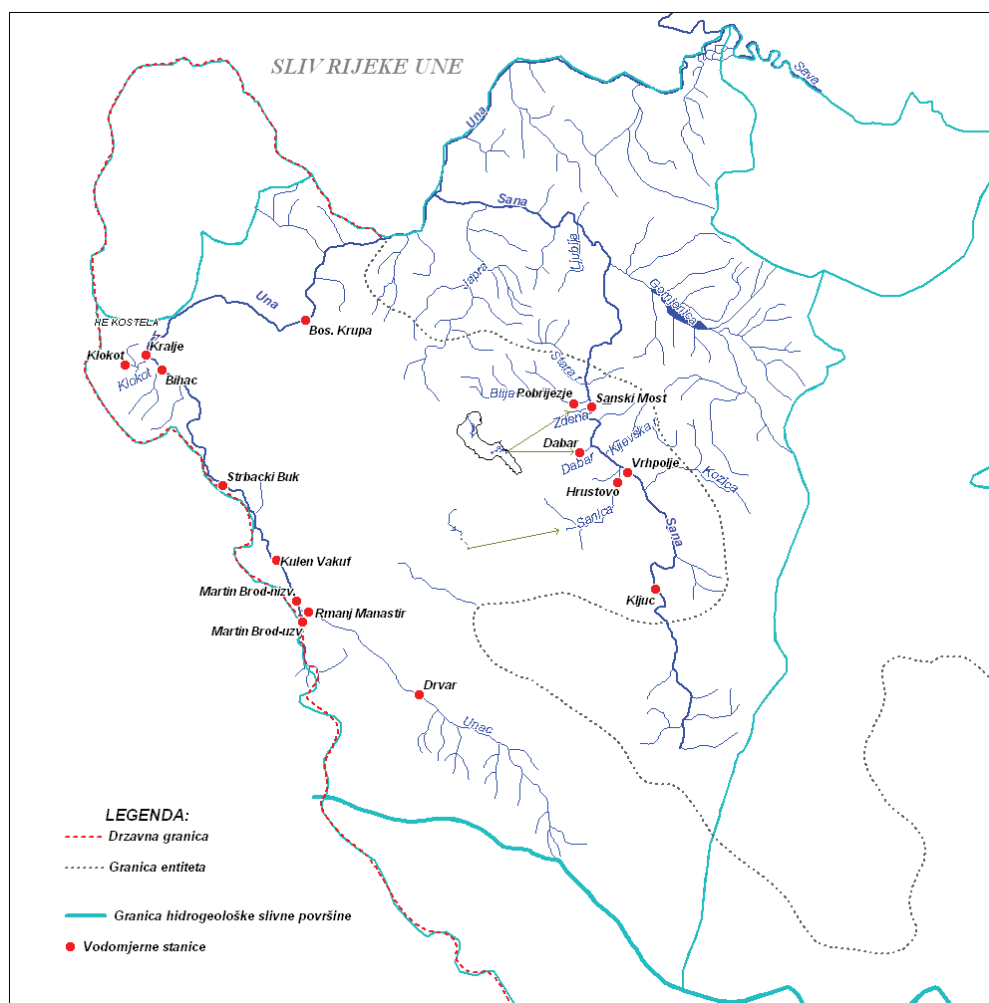


Fig. 2.1.1: The Una river sub-basin

The Glina and Korana rivers sub-basin:

Watercourses in the region of the Federation BiH (Una-Sana Canton) which belong to the Una river sub-basin with the Glina and Korana finally end up in the river Kupa sub-basin in the neighbouring Republic of Croatia. So, for instance, streams Toplica and Mutnica belong to the Korana river sub-basin and the Kladušnica and Glinica belong to the Glina river sub-basin. The size of the sub-basin area of these streams in the Federation BiH is 742 km². In the sub-basin of these streams and their tributaries, there used to be hydrologic stations, but, hydrologic observation series were short, and a part of data unreliable. Therefore, it can be said to be a hydrologically poorly investigated area. For that reason, the estimate of hydrologic parameters has been made on the basis of hydrologic regionalization of the river basin. The graph below in the text presents the Glina and Korana rivers sub-basin.



Fig. 2.1.2: Sub-basin of rivers Glinica and Korana

The Glinica and Korana r. sub-basin – average annual flows (m^3/s) – Federation BiH

No	VS/Location	River	Basin/Sub-basin	Qav/yr
1	Emerging from FBiH to R. Croatia	Toplica	Korana	
	Emerging from FBiH to R. Croatia	Mutnica		
2	Emerging from FBiH to R. Croatia	Kladušnica	Glina	
	Emerging from FBiH to R. Croatia	Glinica		
	Total emerging from FBiH to R. Croatia			16

N.B. Estimate made on the basis of hydrologic regionalization of the Glinica and Korana sub-basin, ending in the r. Kupa sub-basin (R. Croatia)

Table 2.1.3: Hydrologic indicators for the Glinica and Korana rivers sub-basin (m^3/s)

The Vrbas river sub-basin

The river Vrbas originates in the region of the Federation BiH and in its upper reach it borders the Adriatic Sea basin. In the considered area it is of heterogeneous character. In its upper reach all the way up to Donji Vakuf, the stream boasts developed hydrography, i.e. a significant number of tributaries, some of which are of karst character.

Important tributaries in the considered area are: Desna, Kozička river, Bistrica, Veseočica, Prusačka river. It should be noted here that the Kozička river and the Bistrica have sources of expressly karst character (strong stable sources with high water flow regime in the spring) behaving as already well formed streams.

The river Vrbas receives its left-side tributary, the river Pliva, in Jajce. It comes from the Republic of Srpska (RS) with waters formed from a karst region (“West karst”) of the Federation BiH (for instance, water comes from Glamočko polje through sinkholes and then underground channels). The river Pliva is made up of two strong karst springs, and after flowing into the Plivsko lake, it flows further in two ways: The first one is through the town of Jajce by a famous Pliva waterfall as “a biological minimum”. The remaining portion of water flows (by a tunnel) to the Hydro power

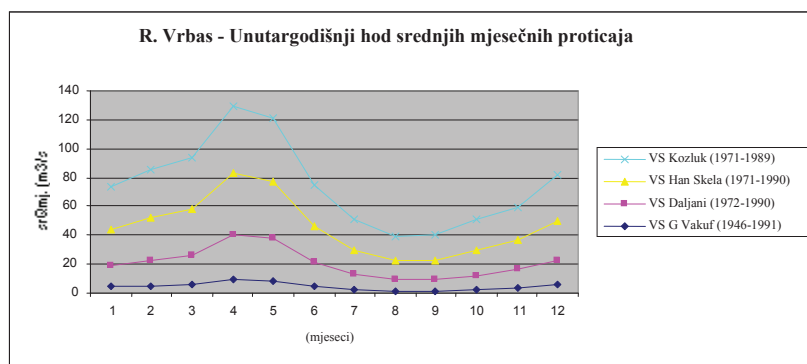
plant Jajce I (in the FBiH). Stochastic regime of the river Vrbas flow is natural up to the town of Jajce. However, downstream of Jajce there are strong deterministic influences caused by the work of the HPP Jajce I and immediately downstream by the HPP Jajce II. Immediately downstream of HPP Jajce II, the river Vrbas goes to the RS. The Vrbas catchment area (with the tributary Pliva) in the Federation BiH covers 2,165 km². It is important to note here that this refers to *hydrogeological catchment* (it means that it also covers a part of Glamočko polje which gravitates toward the spring of the Pliva river).

The table below shows characteristic flow values at hydrologic stations of the Vrbas river sub-basin on the basis of several years' observations, as well as intra-annual average monthly flows for the Vrbas river:

V.S.	Stream	Q _{av.yr} , (m ³ /s)	Av.Q _{min} , (m ³ /s)	Max.Q _{1/T} (m ³ /s)		
				20 yrs	50 yrs	100 yrs
Gornji Vakuf	Vrbas	4.42	0.685	59.6	79	100
Bistrica	Bistrica	2.75	0.800			
Veseočica	Veseočica	2.50	0.560			
Daljan	Vrbas	16.8	6.00	166	220	269
Han Skela	Vrbas	25.0	10.3	217	275	320
Kozluk	Vrbas	28.0	12.2	248	307	380
Milaševci *	Ugar	5.22	1.02	max Q _{REG} = 70,2		

Table 2.1.4: The river Vrbas sub-basin – characteristic flow values

* The border between BiH and RS at Ugar goes mostly along the middle of the watercourse



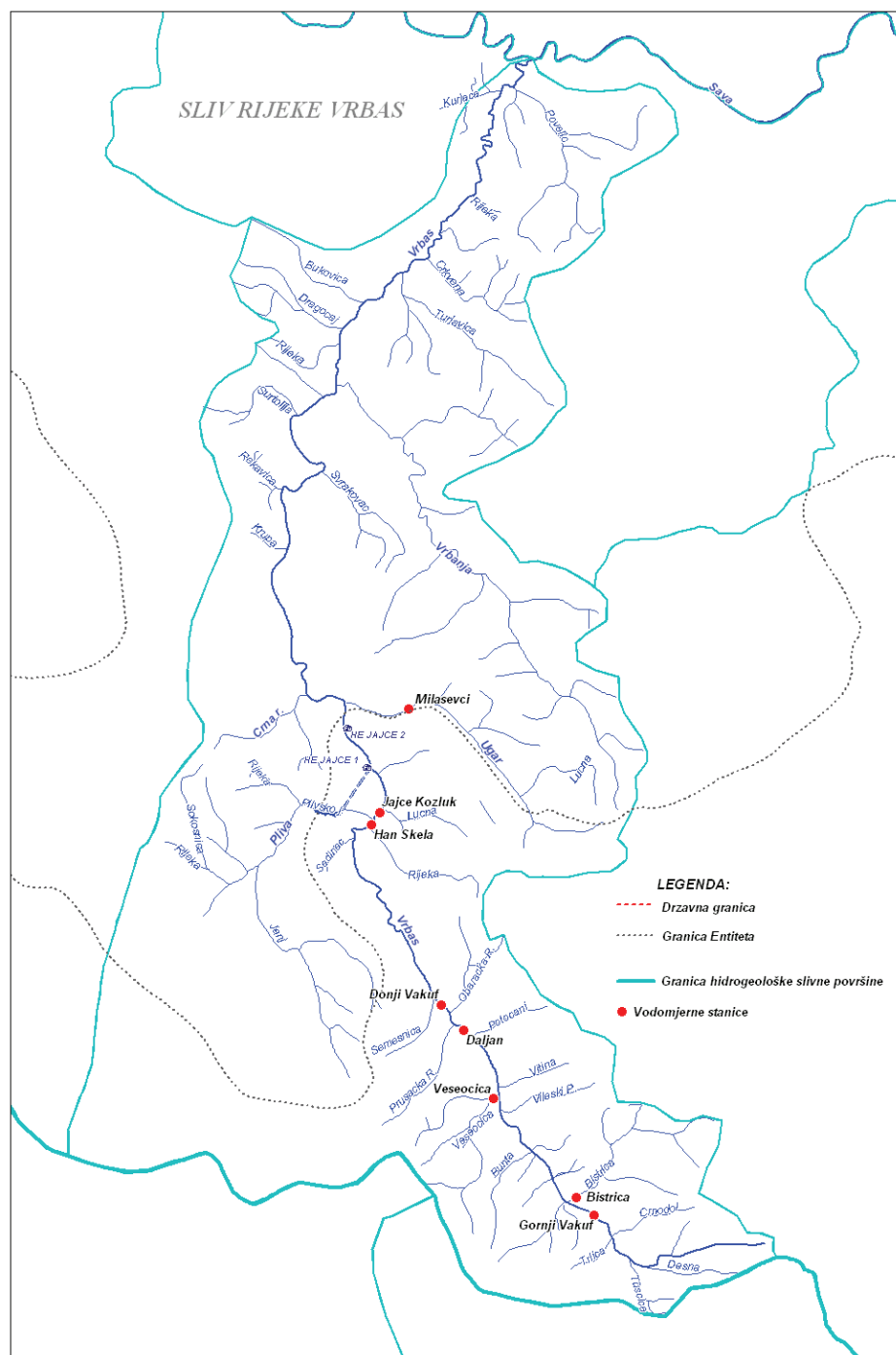


Fig. 2.1.3: The Vrbas river sub-basin

The Bosna river sub-basin:

The river Bosna originates from a strong karst spring in the Federation BiH, receiving in Sarajevsko polje several important tributaries: Zujevina, Željeznica and Miljacka. What characterizes the Bosna river sub-basin is that it belongs to the Federation BiH by a large percentage, and that it has pronouncedly developed hydrography, with some important tributaries and a large number of small tributaries. The impact of karst, unlike in most of river sub-basins in BiH is not significant. The most important tributaries of the river Bosna are: Fojnička river, Lašva, Krivaja, Usora and Spreča. The Bosna river sub-basin is hydrologically investigated to a great extent – a large number of hydrologic stations in which many years' systematic recording of water levels and flow measurements have been carried out. The Bosna river sub-basin in the Federation BiH covers the area of 7,477 km² and, for sure, the orographic area greatly corresponds to hydrogeological sub-basin district. Generally, the flow regime of the river Bosna is stochastic, but in some tributaries there are significant deterministic influences which perturb the natural flow regime. This primarily refers to Sarajevsko polje in which water for water supply of Sarajevo is abstracted from the source of the river Bosna thus impoverishing the river Željeznica (which at Ilidža in summer months has very low flows). There is, also, the impact of the HPP Bogatići on the river Željeznica, the operation of which hinders the natural flow regime of this river. Deterministic influence is mostly pronounced in the right-side tributary of the river Bosna – the Spreča, with the reservoir Modrac which makes the flow regime of the river Spreča downstream of the dam completely artificial. Below in the text are given characteristic flow values at hydrologic stations of the river Bosna sub-basin in the Federation BiH, as well as intra-annual variations of average monthly flows for the river Bosna in the Federation.

VS	Stream	Qav.yr (m ³ /s)	Av.Qmin (m ³ /s)	Max.Q1/T (m ³ /s)		
				20 yrs	50 yrs	100 yrs
Plandište	Bosna	6.28	2.40	26,3	30,8	34,7
Podteljig	Crna rijeka	2.15	0.361	44,3	53	60,3
Bogatići	Bijela	2.56	0.618	62,8	76	86,9
Krupačke stijene	Željeznica	8.93	1.52	151	183	206
Hadžići	Zujevina	1.43	-	56	74	96
Blažuj	Zujevina	2.80	-	102	133	168
Sarajevo	Miljacka	5.71	1.00	152	189	227
Reljevo	Bosna	29.7	7.39	421	495	547
Fojnica 2	Fojnička r,	3.18	0.647			
Homoljska čuprija	Lepenica	5.40	0.840			
Podstijenje	Fojnička r,	16.1	3.95			
Visoko	Fojnička r,	17.2	4.62	255	310	361
Dobrinje	Bosna	57.5	14.6			
Travnik	Lašva	2.80	0.591			
Moščani	Bila	2.00	0.411			
Merdani	Lašva	17.2	4.94	336	390	466
Zenica	Bosna	79.8	20.6	1078	1277	1427
Stipovići	Gostović	6.54	0.590	153	175	192
Zavidovići	Bosna	97.4	22.7	1370	1545	1723
Bioštica	Bioštica	7.30	1.89			
Olovske Luke	Stupčanica	5.50	0.490			
Olovo	Krivaja	12.0	2.38	482	665	824
Zavidovići	Krivaja	24.6	3.85	835	1010	1176
Maglaj	Bosna	12.5	26.9	1870	2190	2442
Kaloševići	Usora	14.6	2.25	461	553	620
Osmaci	Spreča	1.19	0.040			
Krivača	Spreča	4.29	0.224			
Strašanj	Spreča	4.50	0.305			
Donja Višća	Oskova	2.92	0.204	91,9	112	129
Živinice	Gostelja	3.74	0.264	136	160	182
Turija	Turija	2.89	0.499	122	140	152
Modrac	Spreča	16.3	2.50	360	455	534
Dobošnica	Spreča	19.6	-			
Miričina	Spreča	21.6	-			
Kakmuž	Spreča	22.7	-			
Karanovac	Spreča	24.1	-			

Table 2.1.5: The Bosna river sub-basin – characteristic flow values at hydrologic stations

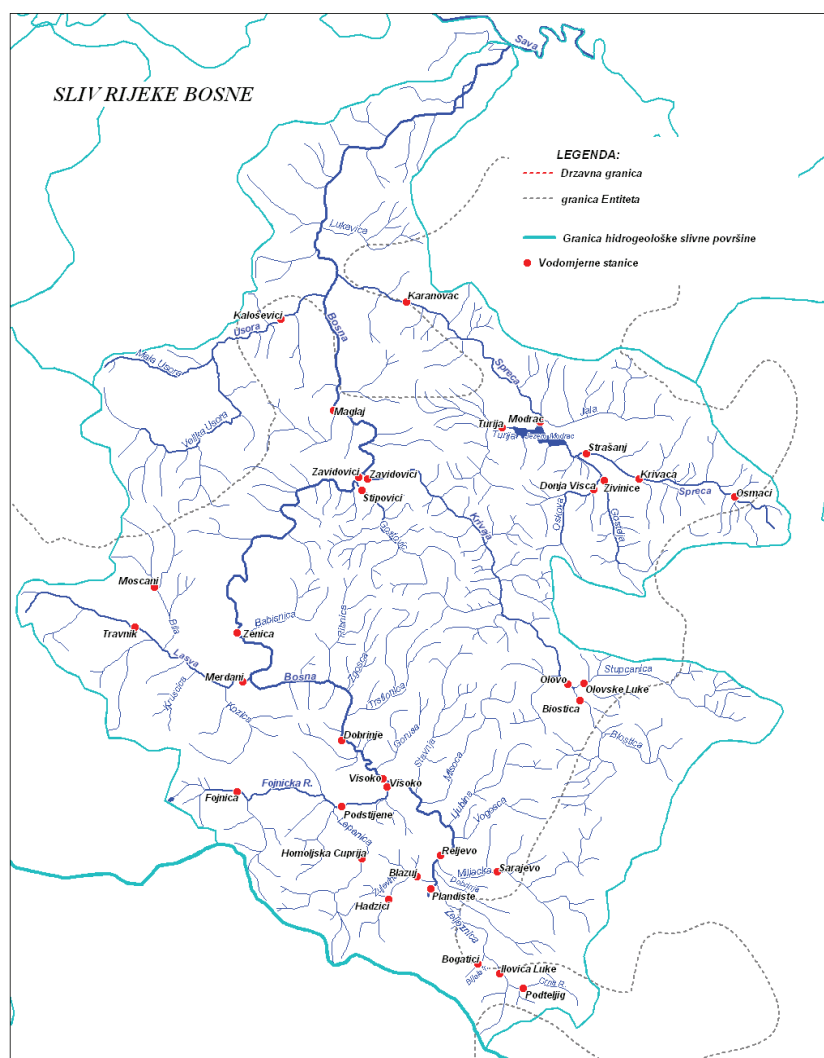
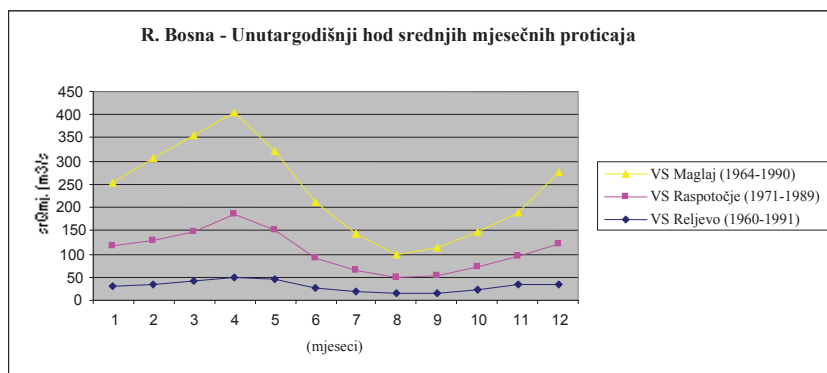


Fig. 2.1.4: The Bosna river sub-basin

The Drina river sub-basin:

Only a small portion of the Drina river sub-basin is in the region of the Federation BiH. The Drina river flows in the Federation BiH in the length of 25 km, including the region of the town of Goražde. Immediately downstream of Goražde, registered is the impact of a backwater caused by the reservoir of the HPP Višegrad. Actually, the flow of the Drina through the Federation BiH is under deterministic influence of the upstream HPP Mratinje in the Republic of Monte Negro. Important tributaries of the river Drina in the Federation BiH are: Kolunska river, the Osanica river, a part of the Prača river and upper reach of the Drinjača river. The river Drina sub-basin in the FBiH covers the area of 974 km². Characteristic values of the river Drina flows for the water gauging station Goražde in the FBiH are given in the following table.

VS	Stream	Qav.yr (m ³ /s)	Av.Qmin. (m ³ /s)	max.Q1/T (m ³ /s)		
				20 yrs	50 yrs	100 yrs
Goražde	Drina	226	43.9*	2993		4329

Table 2.1.6: The Drina river sub-basin, the Drina river – characteristic flows

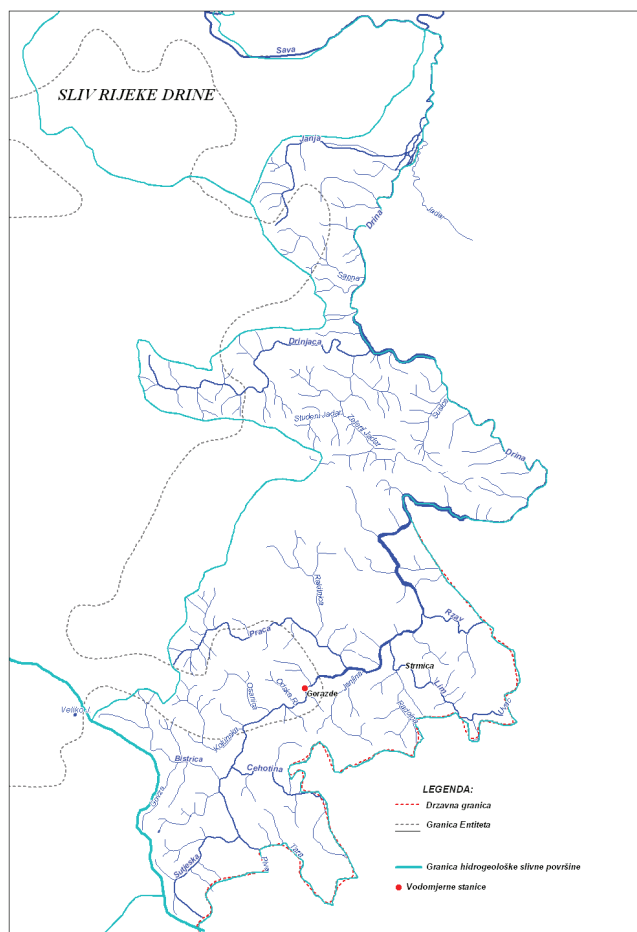


Fig. 2.1.5: The Drina river sub-basin

The immediate Sava river basin:

Like the Drina river sub-basin, the immediate Sava river basin is also located in the Federation BiH only by a small portion. Only a part of the river Tinja sub-basin which belongs to the FBiH has been taken into consideration here as important. Registered are also some small watercourses in Posavina canton, which have not been quantitatively defined due to their minor significance. The size of the immediate Sava river basin in the FBiH is 1,155 km². The river Tinja sub-basin has been quantitatively numerically defined in the following tables and graphically presented in a map of hydrography of the river basin and all characteristic locations. The river Sava follows the Posavina canton of FBiH along all of its length and represents a transboundary watercourse with the neighbouring Republic of Croatia.

Due to the significance of the Sava river as a transboundary watercourse, the table below in the text provides an overview of characteristic flow values for the region of Posavina Canton – Federation BiH, on the basis of data from hydrologic stations in Croatia – VS Slavonski Brod and VS Županja.

Region	River	Qav.yr (m ³ /s)	Max.Q 1/T (m ³ /s)		
			20	50	100
Odžak	Sava	1020	3176	3405	3568
Orašje	Sava	1209	4002	4362	4623

Table 2.1.7: Characteristic hydrologic data for the Sava river

The following table presents characteristic hydrologic indicators for VS Tinja, and a diagram of intra-annual average monthly flows.

VS	Stream	Qav.yr. (m ³ /s)	av.Qmin. (m ³ /s)	Max.Q1/T (m ³ /s)		
				20 yrs	50 yrs	100 yrs
Srebrenik	Tinja	2.25	0.266	154	184	206

Table 2.1.8: VS Tinja – characteristic indicators

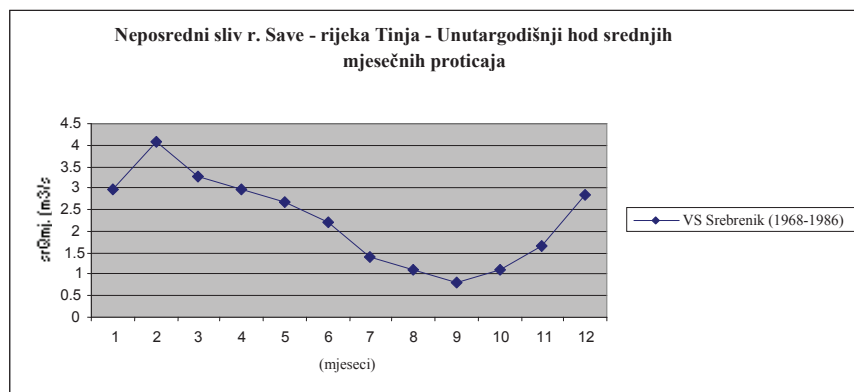




Fig. 2.1.6: Immediate Sava river basin

2.1.3.2. The Adriatic Sea RBD

The Neretva river basin:

The Neretva river is the biggest river in the region of the Federation BiH. With regard to inland waters in the Federation BiH, i.e. waters that originate and get discharged from its surface, the Neretva is also the biggest river.

The main characteristics of this river are: its large catchment area, pronouncedly heterogeneous character, a large number of tributaries, strong impact of karst in the whole river basin (with all specific features of a karst region) – which creates considerable difference between orographic and hydrogeologic river basin district, and expressed deterministic influences on flow, caused by many hydro power stations. The Neretva river flows with most of its course in the region of the Federation BiH. The size of its *hydrogeological catchment* in the FBiH is 5,745 km². On the basis of geographic and hydrographic differences this river basin is divided into three parts, as follows:

- *Upper reach:*

The Neretva river is made up of several strong springs in the Republic of Srpska (located east of Mostar) and flows into the Federation BiH downstream, not far from the place called Ulog.

The main tributaries of the Neretva up to Konjic are: Ljuta, Rakitnica, Šištica (springs from Boračko jezero) Bijela and Tršanica after which the Jablanica lake is formed.

In its upper reach, all the way to Konjic, the flow of the Neretva river is completely a stochastic process which drastically changes immediately downstream of the town of Konjic.

▪ *Middle reach:*

In the middle reach of the river Neretva, the flow is a stochastic-deterministic process, caused by many hydro power plants along this reach: HPP Jablanica, HPP Rama, HPP Grabovica, HPP Salakovac and HPP Mostar. Low water regime depends on the regime of hydro power plants. As to high waters, however, the hydro power plants are “expected” to reduce their detrimental impact. Generally, it can be said that power plants improve the flow regime of the Neretva river in case of extreme flows. Actually, low waters are higher than in natural flow regime (which is important in dry periods of the year) and high water waves are considerably reduced by impact of artificial reservoirs, i.e. by adequate use of storage space.

As to hydrography of this part of the river basin, important tributaries of the Neretva are the rivers: Kraljušnica, Baštica, Neretvica, Rama, Doljanka, Bijela, Drežanka and lakes: Jablaničko and Ramsko (artificial ones) and Blidinje lake (natural one)

▪ *Lower reach:*

The whole Neretva river basin is under karst influence which is more pronounced in the lower reach, from Mostar to the place of entering the Republic of Croatia (Doljani).

What characterizes this part of the river basin is: a large number of strong karst springs (in tributaries and in the very river channel of the Neretva), water inflow to springs from karst poljes – by underground flow, additional deterministic influences by HPP Čapljina (Krupa), HPP Peć Mlini (Trebižat) and many irrigation canals.

Practically all tributaries of the river Neretva in this part of the river basin flow from karst poljes on the left and the right side of the Neretva river: the tributary Jasenica (these are waters from the Lištica river and small streams which end up in Mostarsko blato); the tributary Buna (waters from Nevesinjsko polje); the tributary Bregava (waters from Dabarsko polje and partly from Fatničko polje); the tributary Terbižat (originates in Imotsko polje). There are also strong karst springs along these tributaries: Klokun, Vrioštica, Grudsko vrelo, spring of the Lištica and springs of the Buna and Bunica rivers.

Also characteristic is the left-side tributary Krupa which comes from Deransko jezero – Hutovo blato (wetlands) and receives water from the HPP Čapljina. Deterministic influences are very pronounced in this area. The river Trebišnjica from the direction of Trebinje flows by a canal through Popovo polje from the upper balancing reservoir of the HPP Čapljina (Federation BiH). The river Trebišnjica partly sinks and replenishes waters of Deransko jezero and partly ends up on turbines of the HPP Čapljina. Up to 1992 the average annual flow for the HPP Čapljina was 28 m³/s. Nowadays it is significantly lower and entirely deterministically defined because the flows of the Trebišnjica river are redirected to the HPP Dubrovnik in the Republic of Croatia. Indeed, the impact of the Trebišnjica river on water balance in Deransko jezero and the river Krupa is lower today than it used to be in the system up to 1992 and is difficult to be defined quantitatively. Numerous hydrologic stations in the whole Neretva river basin, with many years’ series of systematic hydrologic observations of water levels and flow measurements make the Neretva river basin hydrologically well investigated. The following table presents characteristic flow values in watercourses of the Neretva river basin in the Federation BiH and graphic presentation of intra-annual rate of average monthly flows.

VS	Stream	Q _{av.yr.} (m ³ /s)	Av.Q _{min} (m ³ /s)	Max.Q _{1/T} (m ³ /s)		
				20yrs	50 yrs	100 yrs
Ulog	Neretva	9.02	0.840	118	128	132
Donja Ljuta	Ljuta	2.87	0.328	40.8	51.0	61.4
Glavatičevo	Neretva	38.6	8.90	497	573	628
Konjic	Neretva	58.0		853	880	1064
Konjic	Trešanica	2.15	0.61	max Q _{REG} = 24.0		
Kralupi	Kraljušnica	2.09	0.273	max Q _{REG} = 32.2		
Idbar	Bašćica	2.13	0.292	max Q _{REG} = 25.5		
Gorani	Neretvica	4.62	0.600	63.4	80	95.7
Jablanica	Doljanka	4.54	0.330	max Q _{REG} = 49.8		
Šanica	Šanica	0.90		max Q _{REG} = 26.8		
Drežnica	Drežanjka	7.48	0.528	137	175	213
Mostar	Neretva	180	50.0	1814	2030	2216
Bačevići	Neretva	201	60.0	1909	2130	2318
Široki Brijeg	Lištica	8.39	0.572	78.0	94.0	114
Ugrovača	Ugrovača	2.13	Dry	104	140	184
Uzarići	Lištica	13.3	Dry	216	270	322
Dom	Jasenica	10.9	dry	36.8	39.0	40.4
Blagaj	Buna	22.4	4.00			
Malo Polje	Bunica	18.8	2.30			
Buna	Buna	42.2	6.30	333	348	363
Žitomislići	Neretva	253	68*	2046	2250	2433
Čapljina	Neretva	255	-			
Rakitovac	Vrljika	9.01	0.557	max Q _{REG} = 82.0		
Grude	Grudsko spring	2.57	Dry			
Peć Mlini-downstr.	Tihaljina	11.1	0.451	max Q _{REG} = 69.9		
Tihaljina	Tihaljina	16.5	0.66	125	134	141
Poljana	spring Klokun	6.54	3.19	24.7	27.1	28.9
Klobuk	Mlade	25.4	4.06	194	210	221
Grabovo spring	Grabovo spring	2.28	Dry	19.2	22.2	24.3
Vitina	Vrioštica	3.21	1.49	10.2	11.0	11.6
Humac	Trebižat	31.4	2.55	201	213	222
Studenci	Studenčica	5.56	1.97	28.3	29.6	30.5
Stolac	Bregava	18.4		54.0	59.0	63.0
Gabela	Neretva	313		2208	2410	2600
Dračevo	Krupa	18.0				
Dračevo	Neretva	331				

Table 2.1.9: Characteristic flow values at hydrologic stations of the Neretva river basin

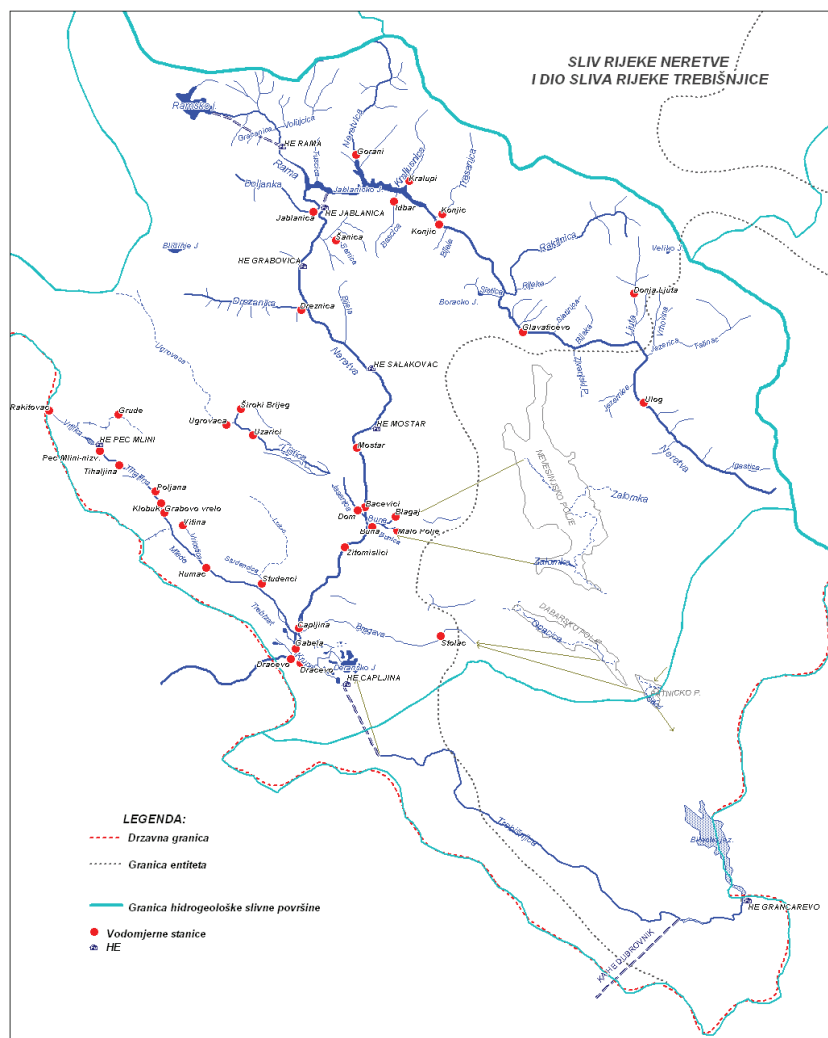
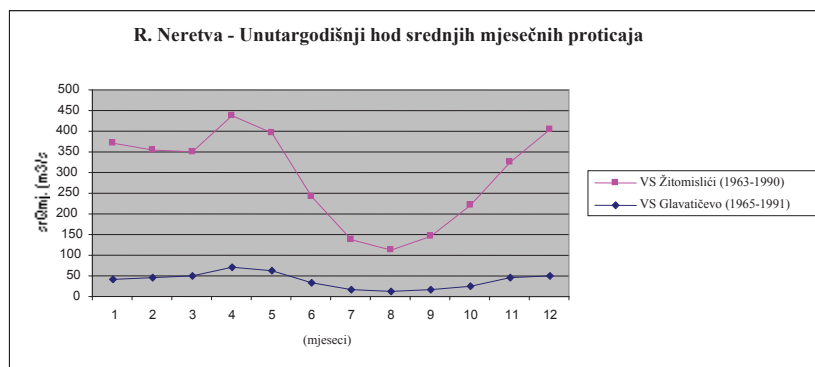


Fig. 2.1.7: The Neretva river basin

The Cetina river basin:

The Cetina river basin (also called “West karst”) which belongs to Bosnia and Herzegovina is located entirely in the region of the Federation BiH and covers the area of 2,876 km².

One of the basic characteristics of the Adriatic Sea RBD to which the Cetina river basin belongs is that it is a karst region. The Cetina river basin belongs to the massif and slopes of the Dinarides, a region with all specific features and phenomena of the karst (strong karst springs, intermittent watercourses, and intermittent reservoirs in karst poljes, dry in summer period, funnel-shaped depressions, sinkholes, estavelles, and the like).

Most of storm water disappears in a karst region (where numerous sinkholes in the river basin receive water acting like huge gulleys and quickly distribute it to the underground). In this concrete case, the spring of the Sana river, spring of the Pliva river and numerous springs along the Adriatic Coast in the Republic of Croatia originate from the region of the so called west karst, or the Cetina river basin.

To be more accurate, all poljes – lower part of Glamočko polje, southern part of Kupreško polje, Duvanjsko and Livanjsko polje belong to the Cetina river basin except for the upper and middle part of Glamočko polje where the rivers Ribnik and Jaruga flow through sinkholes and underground courses to springs of the Pliva and Sana rivers and northern part of Kupreško polje where the stream Mrtvica sinks and ends by underground conduits in the spring of the Pliva river.

The most important watercourses are the Kriva, Jaruga and Ribnik in Glamočko polje, the Milač river in Kupreško polje, the river Šuica in Duvanjsko polje and the rivers Bistrica, Sturba, Žabljak and Ričina in Livanjsko polje.

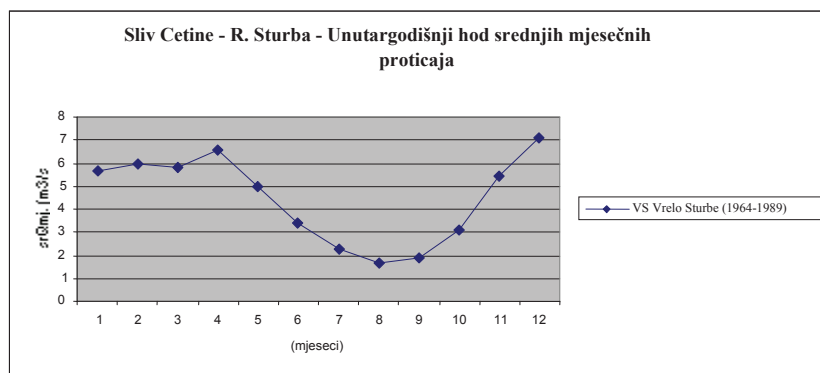
Natural reservoirs are created in: Glamočko polje (retention basin Pučine) from which water is discharged via Dragnić sinkhole to Livanjsko polje; in Duvanjsko polje – retention basin is discharged via sinkhole Kovači to the spring Ričine; Livanjsko polje (flows directly to Buško jezero); and natural retention basin in north-western part of Livanjsko polje from where waters are evacuated by sinkholes Kazanci and Čaprazlije towards the river Cetina.

There is a strong deterministic influence in Livanjsko polje caused by a complex system which collects and discharges waters towards the HPP Orlovac in the Republic of Croatia. A part of this system is Buško jezero (artificial), reservoir Mandak, Drinovački channel (which collects waters from the Bistrica, Sturba and Žabljak) and, finally, the lake Lipa where all the mentioned waters are collected and discharged by a tunnel towards the HPP Orlovac.

The Cetina river basin in the Federation BiH has been hydrologically well investigated owing to many hydrologic stations over the whole Cetina river basin, with many years' series of systematic observations of water levels and measurements of flows. The following table presents characteristic values per hydrologic stations of the Cetina river basin. There is also a graphic presentation of intra-annual variations of average monthly flows of the river Sturba.

VS	Stream	Q _{av.yr} (m ³ /s)	Av. Q _{min.} (m ³ /s)	Max. Q _{1/T} (m ³ /s)		
				20 yrs	50 yrs	100 yrs
Badanj	Badanj	1.04	Dry	17.5	20.3	22.5
Dragnić	Ponor	1.59	Dry	-		
Brda	Milač	0.960	0.200	8.90	10.1	11.0
Gornji Malovan	Milač	0.830	0.090	MAX Q _{reg.} = 11.5		
Šuica	Šuica	2.29	0.110	28.7	38.2	42.9
Mokronoge	Šuica	2.99	Dry	47.5	56.5	63.3
Male Brdine	Drina	2.50	Dry	-	-	-
Jošanica	Ostrožac	0.210	0.012	7.52	10.2	12.5
Kovači-sinkhole*	Šuica	8.20	Dry	190	226	252
Spring Sturbe	Sturba	4.48	1.24	MAX Q _{reg.} = 32.0		
Gornji Žabljak	Žabljak	2.06	0.139	-	-	-
Livno	Bistrica	3.60	0.600	34.8	37.0	38.6
Vrilo	Ričina	8.00	-	-	-	-
Kazanci-sinkhole	Ševarova Jaruga	1.86	0.002	MAX Q _{reg.} = 6.63		
Čaprazlije-sinkhole*	Tovarova Jaruga	2.76	Dry	148	185	201

Table 2.1.10: The Cetina river basin – characteristic flows in its streams



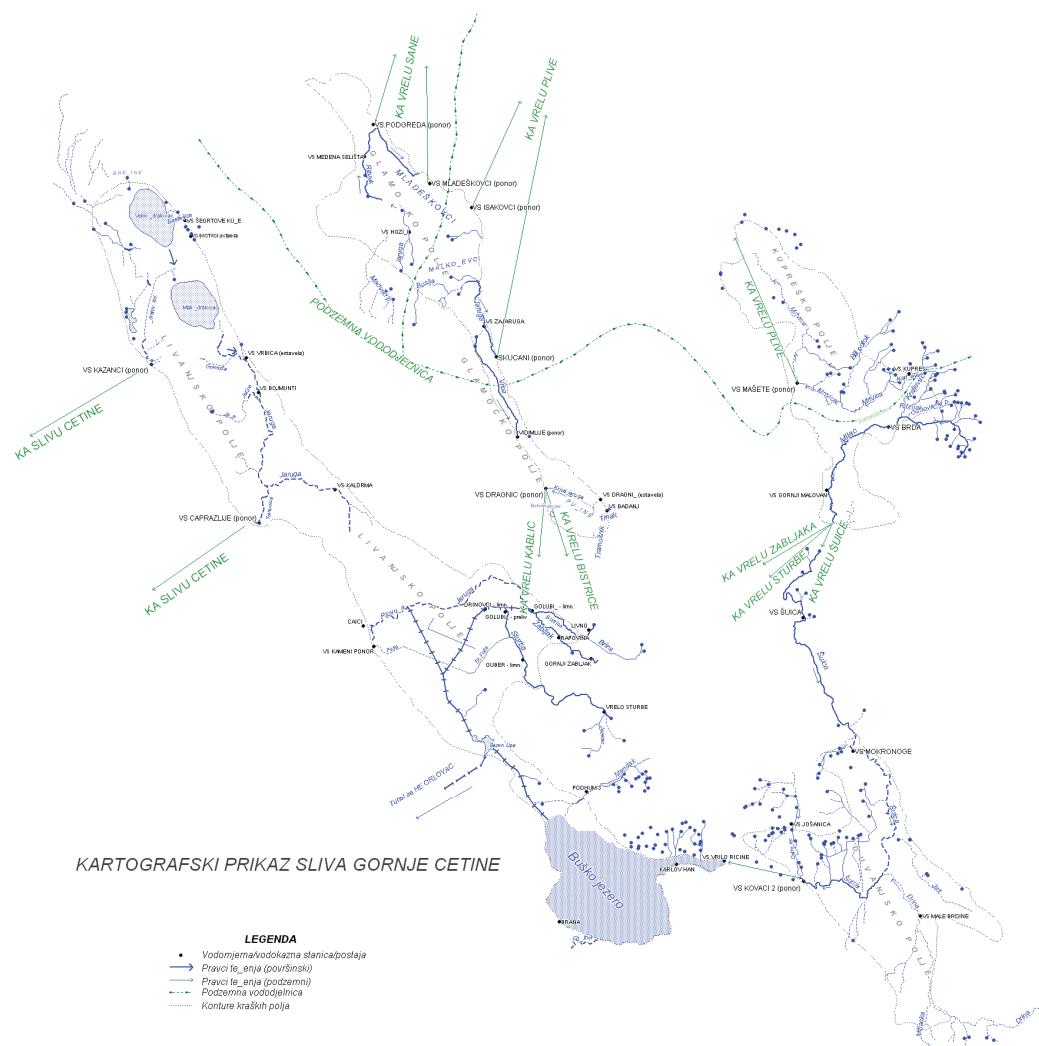


Fig.2.1.8: The Cetina river basin

2.1.4. Balance of surface waters

The balance of surface waters in the Federation BiH is expressed by total water quantities which are formed and/or flow over its territory and divided into its own waters or *inland waters*²⁵ and *transboundary waters* in order to be able to assess the inland water resources of the Federation BiH. Quantities of inland waters are of special importance because hardly can transboundary waters be considered as water resources of a country since it is difficult, for instance, to have control of quality, even of quantity of such waters.

Water balance has been presented in the following tables as:

- Balance for the Sava river and the Adriatic Sea river basins and sub-basins district,
- Aggregate balance of surface waters for the Sava RBD and the Adriatic Sea RBD,
- Aggregate balance of surface waters in the Federation BiH.

2.1.4.1. The Sava river basin district

Total aggregate balance of surface waters for the Sava RBD in the Federation BiH is given in the following table:

River basin /sub-basin district of FBiH	Qav.yr. (m3/s)		
	Inland waters	Transboundary waters	Total waters
Una	142.5	57	199.5
Glina and Korana	15		15
Vrbas	28.4	35	63.4
Bosna	132.8	33.4	166.2
Drina	29.24	214	243.24
Immed. Sava river basin	5		5
TOTAL:	352.94	339.4	692.34
Percent out of total:	51	49	100

Table 2.1.22: Balance of surface waters of the Sava RBD in the Federation BiH

2.1.4.2. The Adriatic Sea basin district

The total balance of surface waters for the Adriatic Sea RBD is presented in the following table:

River basin/Sub-basin district of FBiH	Qav.yr. (m3/s)		
	Inland waters	Transboundary waters	Total waters
Neretva	294	37	331
Cetina	23		23
TOTAL:	317	37	354
Percent out of total	89.5	10.5	100

Table 2.1.12: Balance of surface waters of the Adriatic Sea RBD in the Federation BiH

²⁵ Waters that occur/are formed in the territory of the Federation BiH.

2.1.4.3. Aggregate balance of surface waters

Aggregate balance of surface waters for the area of the Federation BiH is presented in the following tables, in total and per river basin districts.

River basin/Sub-basin district od FBiH	Qav.yr (m3/s)		
	Inland waters	Transboundary waters	Total waters
The Sava RBD	352.9	339.4	692.3
The Adriatic Sea RBD	317	37	354
TOTAL:	670	376	1046
Percent out of total	64	36	100

Table: 2.1.13: Surface water balance on the territory of the Federation BiH

2.1.4.4. Assessment of inland water resources

To give an assessment of *inland water resources* in the Federation BiH, a relationship has been established between these waters and territory of the Federation, and estimated number of inhabitants for the present period. The relationship is given in the following table:

Territory	Inland waters		Number of inhabitants	Available per inhabitant (m3/inhab.)	Assessment of water abundance
	Qav.yr (m3/s)	W (x m3)			
Federation BiH	670.00	21,129.00	2,327,500	9,078.00	Medium abundance in water

Table 2.1.14: Assessment of water resources in the Federation BiH

Criteria used in literature²⁶ for assessment of water resources of a country or a part of it are mainly as follows:

- Very abundant in water more than 20,000 m³/inhab.
- Abundant in water 10,000 – 20,000 m³/inhab.
- Medium abundant in water: 5,000 – 10,000 m³/inhab.
- Poor in water: 2,000 – 5,000 m³/inhab.
- Very poor in water less than 2,000 m³/inhab.

According to the above criteria, the Federation BiH has *medium abundance* of its inland waters.²⁷

²⁶ Hdrology, Part I. Dr. S.Prohaska, Institut za vodoprivredu J. Černi (Institute of Water Management J Černi), Belgrade, R.Serbia, 2003. .

²⁷ Data for some neighbouring countries are as follows: R. Serbia: Q=1,637 m³/inhab. – „area very poor in water“ (information from previous period when the region of Kosovo was included) and R. Monte Negro: Q=30,460 m³/inhab. – „area very abundant in water“

2.1.5. Quality of surface waters

2.1.5.1. Introduction

According to the Water Law²⁸, the term “*surface waters*” denotes “all inland waters except for groundwaters, transitional and coastal waters except for coastal waters belonging to territorial waters”.

Assessment of surface water quality is made on the basis of regular controls and analyses at selected locations. Controls and analyses of surface water quality in Bosnia and Herzegovina were systematically carried out from 1965 to 1991 at 58 gauging stations of river basins and sub-basins of the rivers: Una, Vrbas, Ukrina, Bosna, Drina, Neretva and Trebišnjica. (Analyses from that period did not include groundwaters, lakes and reservoirs). Controls were based on ad-hoc water sampling. Physico-chemical parameters of water quality were defined three times a year (spring, summer, autumn) and biological parameters twice a year (summer and autumn). Constantly checked were standard physico-chemical parameters: temperature, appearance, pH values, alkalinity, dissolved oxygen and saturation percentage, hardness, total solid and suspended matters, COD and BOD, ortho phosphates and total iron. Compounds of nitrogen, ammonia, nitrates and nitrites were regularly checked at 10 sections. Microbiological and biological quality controls were carried out at most stations.

Continuity in monitoring of water quality was interrupted in 1992. Organized control of surface water quality in the Federation BiH was resumed in 1995, or 2005, depending on river basin district and competent agencies.

The Water Law of the Federation BiH in Article 32 envisages *classification of the status of surface water and groundwater bodies* which is defined on the basis of the level of alterations resulting from human activity. By Article 43 of the same Law, it is stipulated that the Government of the Federation BiH shall adopt regulations on *methodology for defining types of surface water bodies and characterization of water bodies of both surface waters and groundwaters*. Neither regulations on the above methodology nor parameters for defining of categories of water bodies have been adopted so far. Therefore, for the purpose of review and illustration of the status of surface water quality, the still valid Decree on classification of waters and coastal waters within the boundaries of SR BiH²⁹ will be used

The surface water quality in the Federation BiH is presented for the period up to 1991 and for the periods 2000,-2005,-2007.

²⁸ Official Gazette of FB-H No, 70/06

²⁹Official Gazette of SR B-H No. 19/80. (**Category I** – water which in natural state, with possible disinfection, can be used for drinking and in food industry, and surface waters for edible fish rearing (salmonidae). **Category II** – water which in natural state can be used for bathing and recreation, for water sports, for rearing of other kinds of fish (cipridae), or which, with usual methods of treatment can be used for drinking and food industry. **Category III** – water that can be used for irrigation and after the usual treatment methods also in industry except in food industry. **Category IV** – water that can be used for other purposes only after adequate treatment).

2.1.5.2. Assessment of water quality status for the period up to 1991³⁰

Characteristic for this period is a big difference between prescribed and actual water quality status, especially for surface waters of the Sava river basin district. Out of 58 gauging stations covered by the programme of regular control (chemical and biological parameters) for the observed characteristic period 1985-1989, water quality was within required category only at 15 profiles. In certain parts of the river Bosna sub-basin noticeable are zones of total water quality deterioration as a consequence of the then industrial effluent pollution. At a large number of stations the quality parameters exceeded even the values for the category IV.

2.1.5.3. Assessment of water quality status for the period 2000,-2005,-2007.

2.1.5.3.1. The Sava river basin district³¹

Comprehensive, systematic and continuous monitoring of water quality in the region of the Federation BiH, in the Sava river basin district, was resumed in 2005. (In the period 1995-2005 individual quality observations were carried out and a number of automatic measuring stations installed).

At 39 gauging stations in the Sava river basin district in the FBiH, in the period from October 2005 to May 2007, six series of investigations were conducted. Analyzed were biological, microbiological and physico-chemical elements of water quality. General findings about water quality for the given period in view of physico-chemical elements are as follows: (i) water of the Bosna river sub-basin is significantly more polluted than sub-basins of the rivers Una, Drina and Vrbas; (ii) the river Una is still the least polluted river; (iii) the biggest pollution sources in the River Bosna sub-basin district are waste waters from public utilities in large urban environments – Sarajevo, Visoko, Zenica, and especially from industrial plants of Tuzla region; (iv) it has been noticed that urban centres Sarajevo and Tuzla produce the highest pollution loads in waters of the Bosna river sub-basin, while industrial centres Zenica and Maglaj produce considerably lower pollution than in the period up to 1991; (v) one positive aspect has been noticed, i.e. that watercourses in the Sava river basin district still possess the ability of self-purification. That is evident in water quality of the river Bosna downstream of Zenica which is significantly better than in waters upstream of Kakanj where impact from pollution from Sarajevo and Visoko is felt; (vi) the highest pollution is noticed in the rivers: Miljacka, Jošanica and Stavnja into which untreated waters from Sarajevo, Breza and Vareš are discharged.

For assessment of the status of surface water quality in terms of biological classification and evaluation of watercourses, used were investigation results which comprised primarily communities of micro vertebrates, and sporadic community of phytobenthos.

³⁰ Material used from the report: Concept of long-term water protection programme, Zavod za vodoprivredu Sarajevo, 1991.

³¹ Used material from report: „Final results of investigations of surface water quality and sediments in streams in the Sava river basin in the Federation BiH.“Zavod za javno zdravstvo Kantona Sarajevo“ (Institute for public health of Sarajevo Canton), July 2007 and „Investigations of surface water quality in the Sava river basin in the FB-H, final report““, Prirodno-matematički fakultet (Faculty of natural sciences and mathematics), Sarajevo, May 2008. (Water quality control was carried out in the period October 2005 – May 2007. During that period six analyses were made on 32, or 39 locations, on the basis of ad hoc sampling. Physico-chemical, microbiological and biological quality controls were carried out).

The following tables present the status of water quality of the Sava river basin district showing percentages of meeting prescribed requirements for categories of streams, in compliance with the afore-mentioned Decree on classification of waters and coastal waters within the boundaries of SRBiH.

The Una river sub-basin

THE UNA RIVER SUB-BASIN	MDK ³²	Meeting prescribed category requirements (%)
		2005-2007
BIOLOGICAL PARAMETERS		
Saprobity index	1.5-2.5	100
MICROBIOLOGICAL PARAMETERS		
Total coliform bacteria at 37°C (N/100mL)	Average	6.413
PHYSICAL-CHEMICAL PARAMETERS		
Suspended matter		
Volatile residue (mg/L)	<30	100
Alkalinity - Acidity		
pH	6.8-8.5	100
Oxygen regime		
Dissolved oxygen (mgO2/L)	>6	100
Oxygen saturation (% O2)	90-75	100
BOD-5 (mgO2/L)	<4	100
COD pot.KMnO4 (mgO2/L)	<12	100
Nutrients content		
Ammonia ion (mg/L)	<0.25	100
Nitrites (mgNO2/L)	<0.05	100
Nitrates (mgNO3/L)	<10	100
Phosphates-o (mgPO4/L)	<0.25	100

Table 2.1.15: Water quality for the Una river sub-basin for period 2005-2007

³² The Water Law envisages classification of water status, i.e. classification of the status of surface water and groundwater bodies, on basis of the level of alterations resulting from human activity. It is anticipated that the status of a water body should be defined by its ecological and chemical status, depending on which is worse. Referential conditions of ecological and chemical status (Article 43 of the Law) are to be defined by the Government of the Federation BiH, which has not been done up to now. Until these by-laws on classification of water status are adopted, the Decree on stream categorization (Official Gazette of SR BiH No. 42/67) shall be applied, according to which all streams, groundwaters, natural lakes and coastal waters within the boundaries of the Federation BiH are divided into 4 categories depending on purpose and pollution degree. **MDK** (maximum permissible concentration) is defined by prescribed categories for certain sections of surface waters in the observed sub-basin area.



Fig. 2.1.9: The Una river sub-basin with gauging stations

The Vrbas river sub-basin:

THE VRBAS RIVER SUB-BASIN	MDK	Meeting prescribed category requirements (%)
		2005-2007
BIOLOGICAL PARAMETERS		
Saprobity index	1.5-2.5	100
MICROBIOLOGICAL PARAMETERS		
Total coliform bacteria at 37°C (N/100mL)	Average	14.977
PHYSICAL-CHEMICAL PARAMETERS		
Suspended matter		
Volatile residue (mg/L)	<30	50
Alkalinity - Acidity		
pH	6.8-8.5	100
Oxygen regime		
Diss. Oxygen (mgO2/L)	>6	100
Oxygen saturation (% O2)	90-75	100
BOD-5 (mgO2/L)	<4	100
COD pot.KMnO4 (mgO2/L)	<12	100
Nutrients content		
Ammonia ion (mg/L)	<0.25	100
Nitrites (mgNO2/L)	<0,05	100
Nitrates (mgNO3/L)	<10	100
Phosphates-o (mgPO4/L)	<0.25	100

Table 2.1.16: Water quality for the Vrbas river sub-basin for period 2005-2007.

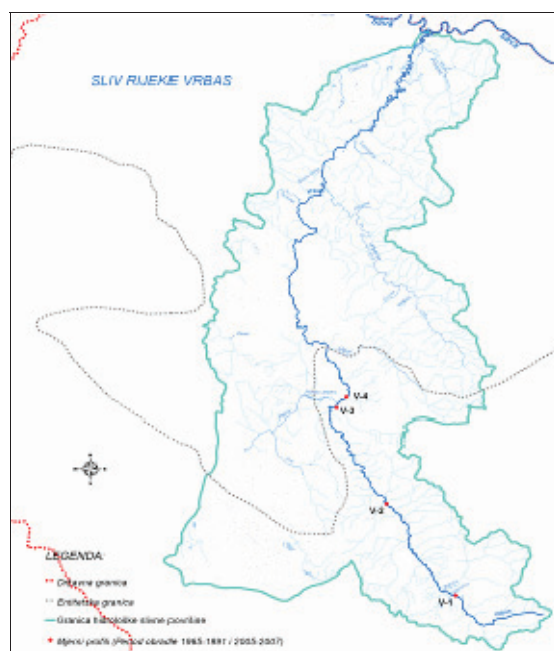


Fig. 2.1.10: The Vrbas river sub-basin with gauging stations

The Bosna river sub-basin:

THE BOSNA RIVER SUB-BASIN	MDK	Meeting prescribed category requirements (%)
		2005-2007
BIOLOGICAL PARAMETERS		
Saprobity index	1.5-2.5	92
MICROBIOLOGICAL PARAMETERS		
Total coliform bacteria at 37°C (N/100mL)	Average	448,297
PHYSICAL-CHEMICAL PARAMETERS		
Suspended matter		
Volatile residue (mg/L)	<30	74.07
Alkalinity – Acidity		
pH	6.8-8.5	92.59
Oxygen regime		
Diss. Oxygen (mgO2/L)	>6	100
Oxygen saturation (% O2)	90-75	96.30
BOD-5 (mgO2/L)	<4	77.78
COD pot.KMnO4 (mgO2/L)	<12	96.30
Nutrients content		
Ammonia ion (mg/L)	<0.25	70.37
Nitrites (mgNO2/L)	<0,05	81.48
Nitrates (mgNO3/L)	<10	100
Phosphates-o (mgPO4/L)	<0.25	81.48

Table: 2.1.17: Water quality for the river Bosna sub-basin for period 2005-2007

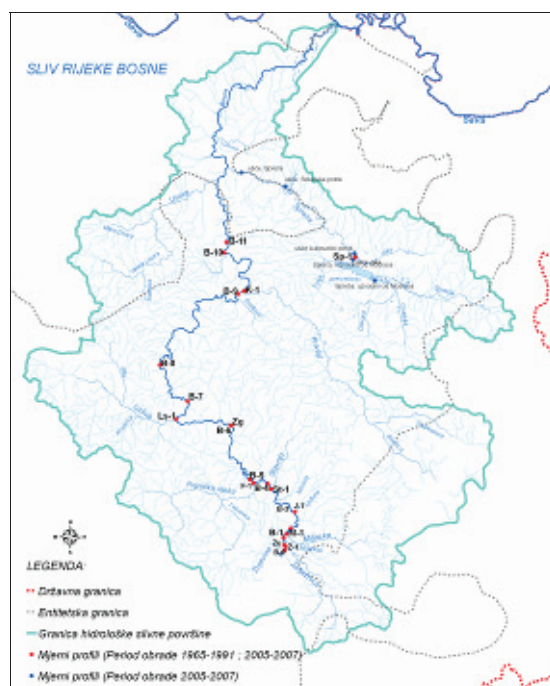


Fig.2.1.11: The river Bosna sub-basin with gauging stations

The Drina river sub-basin:

THE DRINA RIVER SUB-BASIN	MDK	Meeting prescribed category requirements (%)
		2005-2007
BIOLOGICAL PARAMETERS		
Saprobity index	1.5-2.5	100
MICROBIOLOGICAL PARAMETERS		
Total coliform bacteria at 37°C (N/100mL)	Average	9,450
PHYSICAL-CHEMICAL PARAMETERS		
Suspended matter		
Volatile residue (mg/L)	<30	100
Alkalinity – Acidity		
pH	6.8-8.5	100
Oxygen regime		
Diss. Oxygen (mgO2/L)	>6	100
Oxygen saturation (% O2)	90-75	100
BOD-5 (mgO2/L)	<4	100
COD pot.KMnO4 (mgO2/L)	<12	96.30
Nutrients content		
Ammonia ion (mg/L)	<0.25	100
Nitrites (mgNO2/L)	<0,05	100
Nitrates (mgNO3/L)	<10	100
Phosphates-o (mgPO4/L)	<0.25	100

Table: 2.1.18: Water quality for the Drina river sub-basin for period 2005-2007.

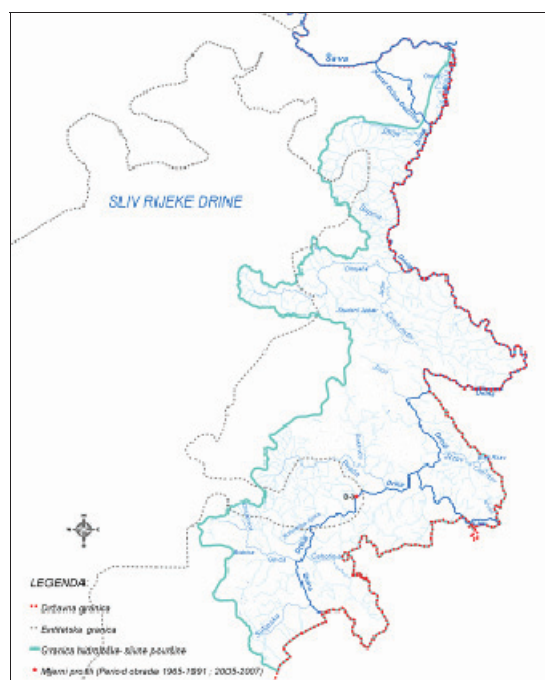


Fig.: 2.1.12: The river Drina sub-basin with gauging stations

2.1.5.3.2. The Adriatic Sea river basin district

The Neretva river basin:

Monitoring of water quality in the Adriatic Sea RBD was resumed in 2000. Beside former gauging stations, the analysis included some new stations in the Neretva and Cetina river basins. Obtained results are illustrated in the following tables. Fig. 2.1.14 shows the river Cetina river basin with gauging stations.

THE NERETVA RIVER BASIN	MDK	Meeting prescribed category requirements (%)
		2005-2007
BIOLOGICAL PARAMETERS		
Saprobity index	1.5-2.5	100
MICROBIOLOGICAL PARAMETERS		
Total coliform bacteria at 37°C (N/100mL)	Average	2,290
PHYSICAL-CHEMICAL PARAMETERS		
Suspended matter		
Volatile residue (mg/L)	<30	100
Alkalinity – Acidity		
pH	6.8-8.5	100
Oxygen regime		
Diss. Oxygen (mgO2/L)	>6	100
Oxygen saturation (% O2)	90-75	-
BOD-5 (mgO2/L)	<4	100
COD pot.KMnO4 (mgO2/L)	<12	100
Nutrients content		
Ammonia ion (mg/L)	<0.25	100
Nitrites (mgNO2/L)	<0,05	100
Nitrates (mgNO3/L)	<10	100
Phosphates-o (mgPO4/L)	<0.25	-

Table 2.1.9: Water quality for the Neretva river basin for period 2005-2007



Fig. 2.1.13: The Neretva river basin with gauging stations

THE KRKA AND CETINA RIVER BASIN	MDK	Meeting prescribed category requirements (%)
		2005-2007
BIOLOGICAL PARAMETERS		
Saprobity index	1.5-2.5	92
MICROBIOLOGICAL PARAMETERS		
Total coliform bacteria at 37°C (N/100mL)	Average	3,683
PHYSICAL-CHEMICAL PARAMETERS		
Suspended matter		
Volatile residue (mg/L)	<30	100
Alkalinity – Acidity		
pH	6.8-8.5	100
Oxygen regime		
Diss. Oxygen (mgO2/L)	>6	100
Oxygen saturation (% O2)	90-75	-
BOD-5 (mgO2/L)	<4	100
COD pot.KMnO4 (mgO2/L)	<12	100
Nutrients content		
Ammonia ion (mg/L)	<0.25	66.67
Nitrites (mgNO2/L)	<0,05	100
Nitrates (mgNO3/L)	<10	100
Phosphates-o (mgPO4/L)	<0.25	-

Table 2.1.20: Water quality of the Krka and Cetina river basins for period 2005-2007



Fig. 2.1.14: The Krka and Cetina river basin with gauging stations

2.1.5.4. Comparison of water quality results

Comparison of the water quality analysis results from the period up to 1991 with the ones from 2000 is important. Namely, later analyses, although made without continuity and separately for various districts, generally display improvement in surface water quality. That is understandable because of reduced industrial activities. This conclusion refers especially to the river Bosna sub-basin in which pollution by industries, apart from waste waters from public utilities of densely populated region, were most pronounced in the period up to 1991. The following graph illustrates comparison of water quality in the two above-mentioned periods in relation to oxygen regime parameters.

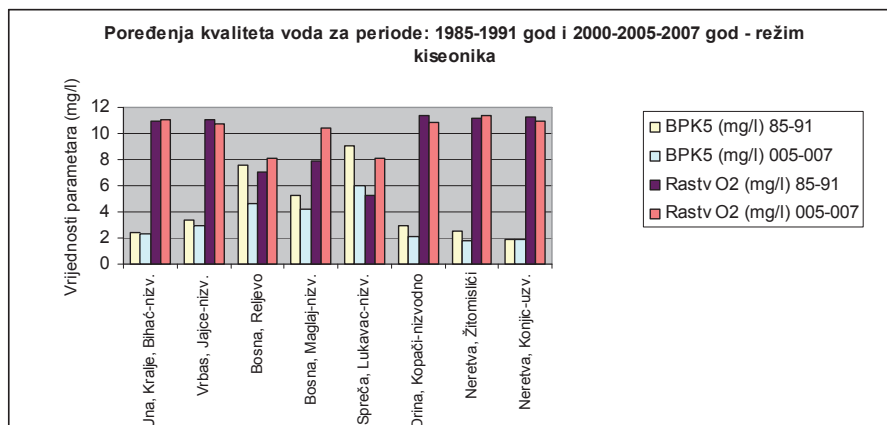


Fig.2.1.15: Comparison of water quality -. Oxygen regime

The results reveal positive quality changes in the river Bosna (Reljevo and Maglaj gauging stations) and especially in the river Spreča (Lukavac station) in terms of indicators of oxygen regime: BOD₅ and dissolved oxygen. It should be noted here that for the period 1985-1991 waters of the rivers Bosna and Spreča, at the stations Reljevo and Lukavac, did not meet requirements for the prescribed category at all. A slight trend of quality improvement in view of these indicators is also noticeable in other watercourses, although it can be said that waters of the rivers Una, Drina, Neretva and also Vrbas, mostly satisfied prescribed category quality in the previous period as well. Positive changes are more evident if suspended matter values in surface waters are also taken into consideration, which is one of the pollution indicators by industrial waste waters that are shown in the following graph:

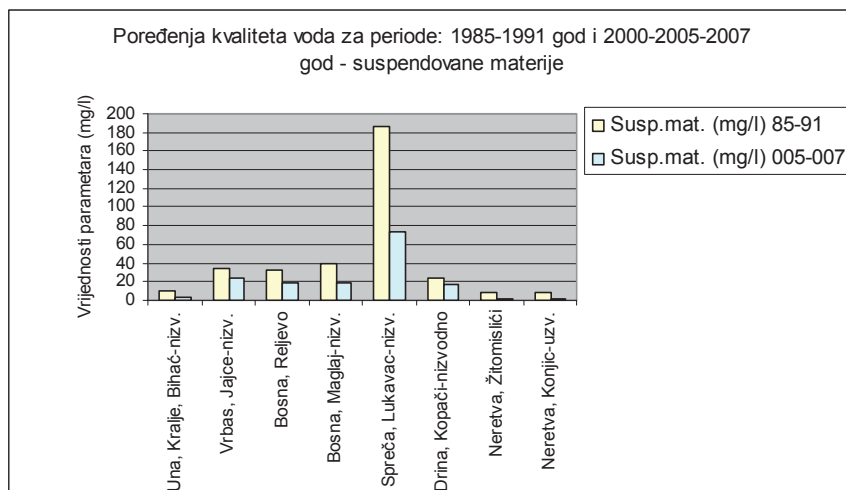


Fig. 2.1.16: Water quality comparison – suspended matter

Significant quality improvement is noticeable at the stations in the river Bosna (Reljevo and Maglaj) and especially in the river Spreča (Lukavac), but also in the river Vrbas (downstream Jajce station). According to this parameter, waters of the Vrbas and Spreča rivers at the afore-mentioned stations did not meet prescribed category requirements in the period 1985-1991. Other streams also show improvement in quality. However, it should be noted that this quality indicator is related to natural conditions and that a longer period of observation is necessary to get a more comprehensive picture.

Comparison of water quality in relation to saprobic index, i.e. biological indicators are shown in the graph below in the text:

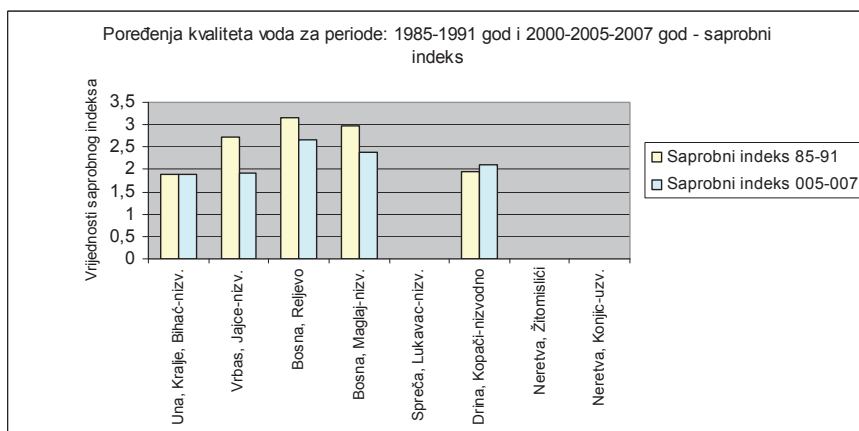


Fig. 2.1.17: Water quality comparison – saprobic index

On the basis of this indicator, quality improvement is obvious in the rivers Bosna and Vrbas which are exposed to the highest pollution load. Lower values of saprobic index, i.e. improvement in water quality, are mostly the result of reduced industrial pollution since the impact of public utilities in view of waste waters has not been significantly changed.

2.2. Groundwaters

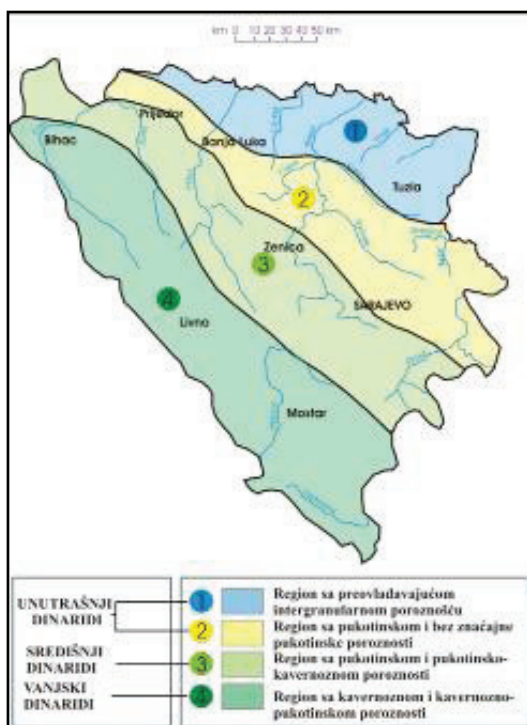
2.2.1. Hydrogeologic investigation degree

The following fundamental hydrogeologic investigations have been carried out in Bosnia and Herzegovina:

- Layout hydrogeological maps 1 : 200,000;
- Printing of hydrogeologic map, 1 : 500,000;
- Elaboration of balance and regime of groundwaters (acc. to fracture, karst-fracture and intergranular rock masses) in 1984 and 1989);
- Register of water structures in scale 1:50,000 worked out in the period 1989-1990 (data not available);
- Working out of Basic Hydrogeological Map started in scale 1: 100,000 (maps Sarajevo, Zenica, Bijeljina, Prača, Metković, and Mostar).

2.2.2. Hydrogeologic regionalization

On the basis of a synthesis of total physical-geographical, geological and hydrogeological characteristics, the territory of the Federation BiH can be divided into three basic hydrogeological units or regions as follows: *Panonian, central and karst region*. It should be noted here that hydrogeologic categorization has been made primarily on the basis of representation of aquifers on the terrain and on the basis of structure and porosity of aquifers that make up the terrain. The following hydrogeologic categories have been singled out:



- Terrain with aquifers of intergranular porosity,
- Terrain with aquifers of intergranular and fracture porosity,
- Terrain with aquifers of cavernous-fracture porosity,
- Terrain with aquifers of fracture porosity,
- Terrains practically without aquifers.

The above categories consist of *hydrogeologic units* characterized by lithologic composition, geologic age or composition in magmatite, i.e. genesis of the Quaternary formations. Within certain categories of the terrain, hydrogeologic units (aquifer descriptors) have been classified into *hydrogeologic groups* according to values of transmissibility coefficients, i.e. water abundance – productivity of aquifers.

Terrains with aquifers of intergranular porosity. The following hydrogeologic members are included into this category: fluvial gravel and sand sediments, occasional clayey sands, fine-grain Neogene sands, diluvial and glacio-fluvial deposits, gravel sands and clays of river and lake terraces, Mio-Pliocene sediments with frequent interlayers of sand and gravel with marl

and clay, and sporadic coaly clays and coal. On the basis of the aquifer characteristics, the above hydrogeologic members have been classified into *hydrogeologic groups*, as follows:

- Group I – high transmissibility coefficient – (more than 10^{-3} m²/s), highly water-abundant aquifer,
- Group II – medium transmissibility coefficient (10^{-3} m²/s), medium water-abundant aquifer,
- Group III – low transmissibility coefficient (less than 10^{-4} m²/s), aquifer with predominantly low water-abundance,
- Group IV – various transmissibility coefficients, aquifers of various water abundance,
- Group V - various, predominantly low transmissibility coefficient, aquifers of various water-abundance, mainly low.

The above shows that the most important aquifers within alluvial formations are in the terrains of northern Bosnia (region of Odžak, Orašje and Gradačac). Given the thickness of gravel-sand formations and spatial position in relation to rivers, a conclusion may be drawn that the presence of aquifers is almost regularly found in direct hydraulic contact with very renewable quantities of groundwater. The water quality is directly dependent on lithologic composition of the hinterland and for the time being is mostly drinkable. According to aquifer characteristics, the first and partly the second hydrogeological group are present in these terrains.

Terrains with aquifers of intergranular and fracture porosity are the ones which are made up of Miocene and Oligo-Miocene complexes in which interlayered are clays, sands, gravels, sandstones, conglomerates, marls and limestones that form the underlying stratum of Neogene sediments. In this hydrogeologic group are found mostly discontinual aquifers with various, mostly low transmissibility coefficient, and mostly with low water abundance, except for parts of northern Majevica made up of Miocene limestones. (an example is the Dinažić source area). This category presents southern parts of the Panonian basin bordering the central region – northern region of Majevica and Sarajevo-Zenica basin.

Terrain with aquifers of cavernous-fracture porosity. Seven hydrogeologic members are within this category, covering large limestone complexes of the Outer Dinarides' carbonate platform (the largest part belongs to the Adriatic Sea RBD). Presented are layered and massive limestones, occasionally with dolomites, marly thin-layered limestones, marbles, limestones, dolomites in alternation, dolomites, dolomitic limestones, limestone conglomerates and breccias and Neogene limestones with smaller sandstone intercalations. The above lithofacies-hydrogeologic units are divided into two groups. Only one hydrogeologic member belongs to the first group, presented by intensely karstified layered and massive limestone complexes with interlayers of dolomites, with aquifers of exceptionally high transmissibility, i. e. areas with high water-abundance and mostly with large regions. Medium karstified carbonate rocks belong to the second group: limestones, dolomites, marbles, limestone conglomerates and breccias. In view of water abundance they come behind the first group and occur as rock mass in a relatively small area. The above-mentioned rocks of this category create terrains in which the evident hydraulic mechanism is mainly free. The presence of aquifer below local erosion base is possible in all hydrogeologic units of this group where depth of karstification is lowered beneath it.

Terrains with aquifers of fracture porosity. This category covers the terrains which in lithological composition are presented mostly by limestones, marly limestones and sandstones. There is no division into hydrogeologic groups because the considered aquifers are mostly of low transmissibility, low productivity and mainly of small local space. Hydraulic mechanism of the aquifers is mainly free, seldom under pressure.

Terrains mainly without aquifers. This category covers several hydrogeologic units which in their lithologic composition are made up of flysch and flysch-like complexes, volcanogenic-sediment formations, laterite clay, marly clay, sand and gravel clay, marls, shales, marly limestones, massive dolomites, and magmatic and metamorphous rocks. It should be mentioned here that terrains of this category cover a large expanse of the Dinarides and the Vardar zone. Although there are some small local aquifers with exceptionally low productivity, the largest area is made of impermeable rock masses. From hydrogeologic point of view, however, they can play a big role as impermeable floor or lateral barrier of the important or leading aquifers on the territory of the Federation BiH.

2.2.3. Review of groundwater reservoirs with reserves balance

The review of groundwater reservoirs, with reserves balance, is made separately for:

- The Sava river basin district, and
- The Adriatic Sea river basin district.

Defined are positions and borders of groundwater bodies for:

- Aquifers of intergranular porosity, and
- Aquifers of karst-fracture porosity.

2.2.3.1. Locations, borders and characterization of groundwater bodies with balance of reserves

Preliminary defining of groundwater bodies for various aquifers has been done on the basis of geological borders of water bodies; hydrologic (hydraulic) borders of water bodies and inlet points (in case of sinking waters) and outlet points (springs) which control the zone of recharging.

The method of borders defining has been adjusted in compliance with the kind of aquifer porosity. For intergranular porosity, mostly used were hydrodynamic models and expert assessments on the basis of data on individual abstraction and granulometry of the aquifer. For aquifers of karst-fracture porosity, hydrogeologic and geologic maps were used, data on defining of underground conduits (by dyeing) of sinking zones, karst springs and also expert estimates. Basic classification of groundwater bodies depending on type of aquifer, its way of flowing or its discharge has been defined as:

- Entirely separate (unconnected) water bodies of groundwaters, as in case of aquifers of intergranular porosity, which are mainly recharged from watercourses along which they occur,
- Connected groundwater bodies which are mainly found in aquifers of karst-fracture porosity with recharge predominantly by precipitation or karst streams through fracture zones and with discharge by several springs or spring zones.
- Water bodies of sub-artesian, artesian or combined type.

The following large groundwater bodies in the Federation of Bosnia and Herzegovina have been identified, as follows:

The Sava RBD			The Adriatic Sea RBD		
Aquifers of intergranular porosity			Aquifers of karst-fracture porosity		
No.,	Name	Area (km2)	The Neretva river basin		
1	Sarajevsko polje	47.40	No.	Name	Area (km2)
2	Krekanski bazen	62.75	1	Tribistovo-Posušje-Grude	259.67
3	Sprečko polje	74.00	2	Klobuk-Vitina-Tihaljina	544.97
4	Gračanica-I	4.62	3	Mostarsko blato	233.76
5	Lohinja	2.07	4	Radobolja-Studenci	449.81
6	Okanovići-Gradačac	6.77	5	Prenj	453.24
7	Odžak	41.52	6	Drežnica	71.24
8	Orašje	28.92	7	Čvrsnica	251.50
Aquifers of karst-fracture porosity			8	Velež	294.79
No.	Name	Area (km2)	9	Neum	211.54
1	Vranica	134.30	The Cetina river basin		
2	Vlašić - Čemernica	460.15	1	Kupres	285.95
3	Igman - Bjelašnica	217.59	2	Staretina	395.01
4	Northern Majevica	36.65	3	Ljubuša	643.81
5	Stupari	92.06	4	Southeast of Buško blato	205.79
6	Gračanica (near Živinice)	24.97	Aquifers of intergranular porosity		
7	Plješevica	108.22	The Cetina river basin		
8	Velika Kladuša - Cazin	345.93	1	Imotsko polje	68.7
9	Grmeč - Sretetica - Vitorog	2,375.30			
10	Unac	1,521.35			
11	Ass. Gračanica	2.48			
12	Tahirovići-Čoralići	8.73			
13	Mionica	1.43			
14	Milkino Vrelo	2.64			
15	Očevja	8.53			
16	Emerge Suha	11.02			
17	Mošćanica-Crnil	3.75			
18	Buci	0.60			
19	Tocila	2.63			
20	Arapka-Buget	12.72			
21	Požarna	3.82			

2.2.1 Review of groundwater bodies in the Federation BiH

The following Figure illustrates distribution of groundwater bodies:



Fig.2.2.1: Delineation of groundwater bodies in the region of the Federation BiH (1. Water bodies in aquifers of karst-fracture porosity, 2. Water bodies in aquifers of intergranular porosity)

2.2.4. Aggregate balance of groundwater reserves

2.2.4.1. Intergranular aquifers

- The Sava RBD:

No.	Name of water body	Category (m ³ /s)					Reserves balance m ³ /s	Total reserves m ³ /s
		A	B	C ₁	C ₂	D ₁ + D ₂		
1	The Bosna r. sub-basin	0.960	0.350	0.830	0.600		2.140	2.740
2	The Spreča r. sub-basin	0.330	-	0.100	0.230		0.660	0.890
3	Immediate Sava river basin	0.148	-	0.079	0.070		0.227	0.297
Total:							3.310	3.927

▪ The Adriatic Sea RBD

No.	Name of Water body	Category (m ³ /s)					Reserves balance m ³ /s	Total reserves m ³ /s
		A	B	C ₁	C ₂	D ₁ + D ₂		
1	The Neretva river basin (area of Gabela & Neum)	0.100		0.300	0.150	0.500	0..400	1.050

2.2.4.2. Karst-fracture aquifers

▪ The Sava RBD:

No.	Name of water body	Category (m ³ /s)					Reserves balance m ³ /s	Total reserves m ³ /s
		A	B	C ₁	C ₂	D ₁ + D ₂		
1	The Bosna r. sub-basin	1.724	1.215	1.555	1.650	1.290	4.494	7.434
2	The Una sub-basin	0.650	0.980	5.14	4.740	2.470	6.770	13.980
3	The Sana sub-basin	0.140	0.318	1.980	1.250	1.550	2.438	5.238
4	The Vrbas sub-basin	0.077	0.270	0.550	0.440	0.270	0.897	1.607
Total:							14.599	28.259

▪ The Adriatic Sea RBD:

No.	Name of water body	Category (m ³ /s)					Reserves balance m ³ /s	Total reserves m ³ /s
		A	B	C ₁	C ₂	D ₁ + D ₂		
1	The Neretva river basin	1.980	5.42	9.070	8.140	6.870	16.470	31.480
2	The Cetina river basin	0.156	0.370	1.775	0.975	1.185	2.301	4.461
Total:							18.771	35.941

Categories of groundwater reserves:

A
B
C₁
C₂
D₁
D₂

Degree of carried out investigations and defining of the reserves elements:

Completely investigated and defined
Investigated and defined
Partly investigated and defined
Tentatively investigated and defined
Assumed
Estimated

(Illustration of degree of carried out investigations and defining of categories of groundwater reserves)³³

³³ Groundwater reserves of categories A,B, and C₁ belong to **balance reserves** and are defined for certain finding places.

Reserves of categories C₂, D₁ and D₂ are considered as **potential**, out-of-balance reserves and are given for a wider area – sub-basin or water-bearing environment.

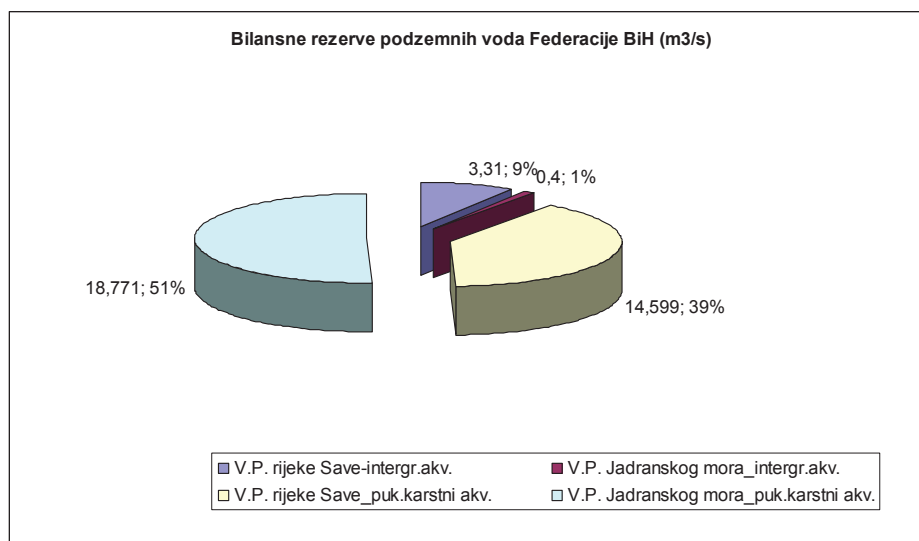


Fig.2.2.2: Graphic presentation of aggregate balance of groundwater in the Federation BiH

2.2.5. Mineral, thermal and thermo-mineral waters

Mineral, thermal and thermo-mineral waters of the Federation of Bosnia and Herzegovina, as renewable resources, play an important role in economic and social life from the point of view of ecologically and economically sustainable investigations, use and their protection. The considered waters are widely applied in balneology, medicine, recreation, sports, tourism, water bottling industry, extraction of salt and gas from water, water supply, using heat water energy, understanding of geological elements, improvement of balneological – medical scientific methods. Besides, there are some types of very effective waters in the Federation BiH with specific physico-chemism that cannot be found in a wider area of the Balkans, which also justifies the need for their investigations.

These waters represent exceptional amenity that can be used in various economic activities, but also for export of potable, mineral and medicinal waters. Bosnia and Herzegovina are much lagging behind other developed countries in view of polyvalent investigation and use of waters. It is necessary, therefore, to work on this issue from expert, scientific and applicative point of view. Even the production of bottled mineral waters in BiH is 10 to 20 times as low as in the neighbouring Croatia and Serbia, while export from BiH is almost negligible.

Water usage is closely linked to the degree of its investigation. Actually, it is only through complex knowledge of all water characteristics that one can define optimal way of abstraction, regime of use, adequate protection and polyvalent application. As renewable alternative natural resources and substituents of classical energy sources, these waters are widely used in various economic branches, from medicine to power generation. The existence of these inadequately investigated water-abundant resources requires multi-disciplinary and phasal investigations in order to provide their polyvalent and optimal use.

Mineral, thermal and thermo-mineral waters of the Federation BiH are found at many locations either in natural form (springs) or in the form of artificial structures – dug wells, bored wells and drilled wells – at 163 locations, among which mineral waters are the most numerous. Poly-

disciplinary and phasal investigations and abstractions at many reservoirs of mineral, thermal and thermo-mineral waters have been intensified in the last 50 years or so in Bosnia and Herzegovina, revealing large capacities of good quality and effective waters; their indicators and a wide scope of application have been identified.

2.2.5.1. Basic data

There are 163 reservoirs of mineral, thermal and thermo-mineral waters in the Federation BiH. Among them 101 are of mineral water, 39 of thermal water and 23 of thermo-mineral water. The most numerous are mineral waters, then thermal and thermo-mineral waters. Mineral waters at springs only are most numerous (82), followed by thermal waters (18) and by only (6) thermo-mineral waters which means that thermo-mineral waters are mainly investigated by boreholes. At 92 locations of mineral water with springs, there are 130 springs; at 29 locations of thermal water there are 60 springs, and at 15 locations of thermal water there are 44 springs. Drilling was done at 56 locations out of which 26 of them were without springs. The total number of boreholes is 134. Out of 101 reservoirs of mineral water only 19 of them were bored; out of 39 thermal water locations, boreholes were made in 20 of them; and finally, out of 23 thermo-mineral water locations, boreholes were made in 17 of them. Thermo-mineral waters with temperatures lower than 40°C were more investigated than those with temperatures above 40°C. Waters with higher temperatures were investigated coupled with oil drilling some 25 or more years ago, which is the reason for their being less investigated.

Total yield of the considered waters amounts to 5230 l/s. Mineral waters have the highest yield (3780 l/s) (the spring Klokun participates in this amount with 3600 l/s minimum). Thermo-mineral waters have the lowest yield – 600 l/s. The yield is related to minimum exploitable capacities of the reservoir. Without the Klokun spring, the total yield of mineral waters is the lowest and that of thermal waters is the highest. At all locations where positive borings were carried out, higher yields were obtained in boreholes than in springs.

The overview given below shows poor extent of investigation of all waters. A conclusion can be drawn that thermo-mineral waters were best investigated, and mineral waters least investigated. Mineral, thermal and thermo-mineral waters in the Federation of Bosnia and Herzegovina exist at numerous locations in the form of natural phenomena – springs, and in the form of man-made structures – dug wells, bored wells, and drilled wells – as shown in the following table and the following figure.

Type of water	Number of reservoirs with springs (without boreholes)	Number of reservoirs with springs and boreholes	Total number of springs	Total number of boreholes	Number of reservoirs with boreholes (without springs)	Total number of reservoirs	Total yield of boreholes and springs (l/s)
Mineral	82	10	130	37	9	101	3780
Thermal	18	11	60	42	9	38	1450
Thermo-mineral	6	9	44	55	8	23	600
Total	106	30	234	134	26	162	5830

Table2.2.6: Basic data on water reservoirs, springs and boreholes

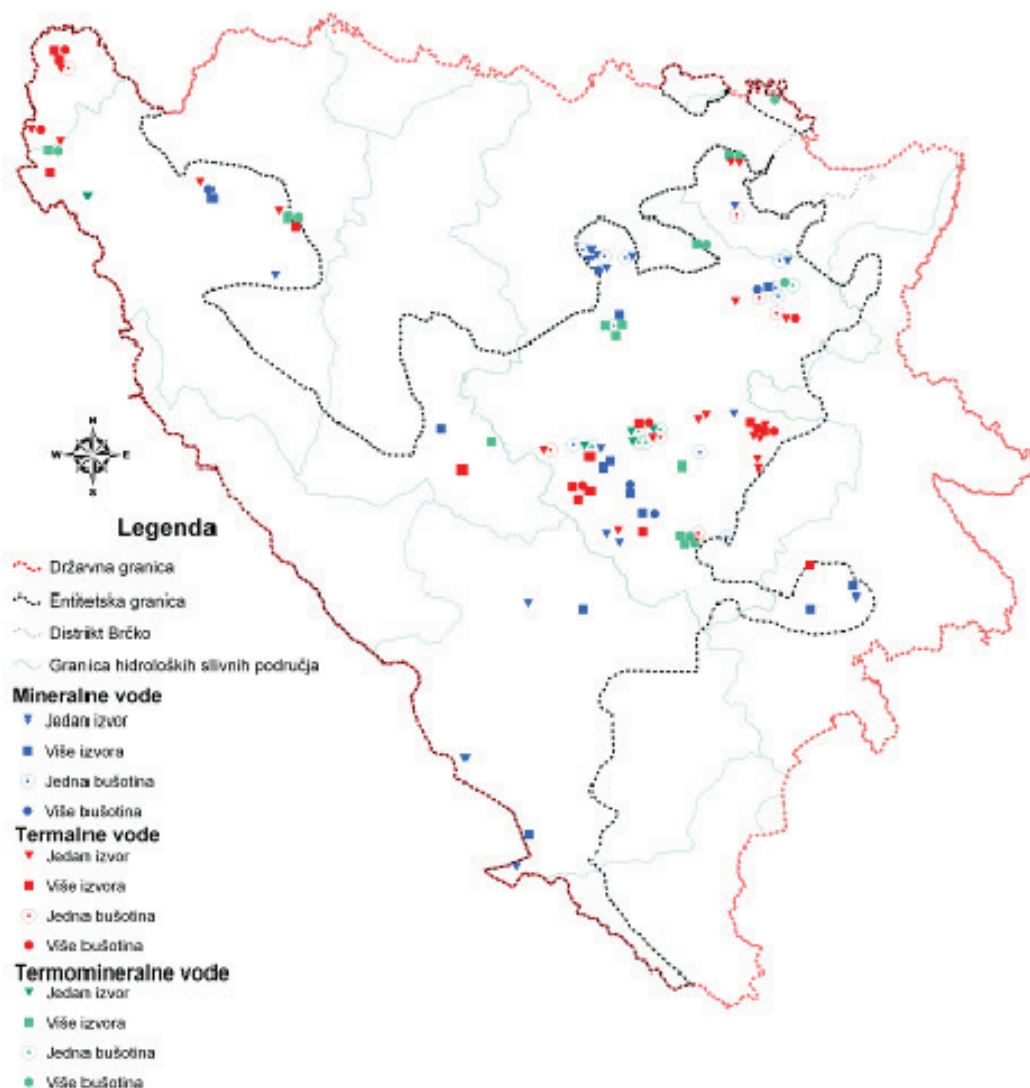


Fig. 2.2.3: Review of reservoirs of mineral, thermal and thermo-mineral waters in the Federation BiH

3. State of Affairs in the Area of Water Management

3.1. Water Management Legal Framework in Bosnia and Herzegovina and in the Federation of Bosnia and Herzegovina

3.1.1. Competences of Bosnia and Herzegovina

The current state of affairs in the area of water law of Bosnia and Herzegovina (BiH) have exceptionally specific qualities making it different from national systems of water law in the neighbouring countries, i.e. the countries of South-Eastern Europe. These specific qualities arise, primarily, from the constitutional character of Bosnia and Herzegovina, consisted of the entities – the Federation of Bosnia and Herzegovina and Republika Srpska, as well as Brčko District.

In accordance with the Constitution of BiH and the Constitutions of the Federation of BiH and Republika Srpska, and pursuant to the Brčko District Arbitration Award, the competences over the water management (i.e. the competences over development, protection, use and protection against adverse impacts) rest with the entities and Brčko District. The analysis of the BiH constitutional and legal framework indicates that, as opposed to numerous other peace agreements that were concluded at different times, the Dayton – Paris peace agreements do not contain specific and clear provisions that would be associated with the BiH national water resources, i.e. the principles that should be the guidance for the constitutive elements of the BiH state, including the entities and Brčko District, in their management of the shared water resources (the resources intersected by entity or district border line). Therefore, the BiH authorities have no competences over regulating these inter-entity relations. In addition, there is no reliable institutional and procedural system for resolving any possible controversies and disputes regarding management of the shared water resources.

At the same time, the BiH foreign policy falls under the competence of the BiH institutions. The entities are entitled to establish special relations with the neighbouring countries in compliance with the sovereignty and territorial integrity of BiH and, upon approval granted by the Parliamentary Assembly of BiH, the entities may enter into agreements with other countries and international organizations. In terms of BiH water resources management, this means that only BiH has competences to enter into relevant international agreements (both multilateral and bilateral); however, the entities and Brčko District are those that are competent for execution of such agreements. This constitutional arrangement has enabled establishment of the competence of the Ministry of Foreign Trade and Economic Relations of BiH for pursuing certain activities and tasks. The Natural Resources, Energy and Environment Department within this Ministry, is accordingly competent for pursuing legal and standardization-related activities, studies and research, as well as the information and documentation-related activities, that are, *inter alia*, related to:

- Drafting of laws and regulations in the area of water;
- Development of expert analysis, information and proposals related to the state of affairs in the area of water;
- Determining strategy and development policies in the area of water;
- Proposing of measures for improvement of the situation;
- Collecting, monitoring and analyzing data on water resources;
- Monitoring and implementation of the international and national initiatives, conventions, projects and programmes in the area of water;
- Informing the institutions in the country and abroad of the situation in the area of water;

- Cooperation with similar institutions abroad and in the country in various forms, should this be in the best interest of BiH;
- Operation with the relevant institutions at the state and at the entity level, respectively;
- Analytical monitoring and development of expert analysis, information and estimations;
- Coordination of measures in the field of rational utilization of water resources, regionally and globally;
- Any other activities within the international and national cooperation scheme that prove to be necessary for the purpose of adequate monitoring of the situation, applying the policies and implementing the required measures and projects for the purpose of sustainable water management.

3.1.2. Water Law of the Federation of BiH

3.1.2.1. Background

The area of BiH, and thus the Federation of BiH, belongs to the Adriatic Sea and Black Sea basin districts, where an extensive multilateral cooperation in water management has been already established amongst the pertaining countries. In view of that, there is a clear unequivocal necessity of up-to-date fulfilment of the BiH obligations in accordance with, for instance, the Convention on the protection and use of transboundary watercourses and international lakes (the Helsinki Convention), the Convention on cooperation for the protection and sustainable use of the river Danube, the Framework Agreement on the Sava river basin and the Protocol on the Navigation Regimen attached to this Agreement. These international frameworks have been established for the purpose of accomplishing sustainable water management, including preservation, improvement and rational utilization of surface water and groundwater within the Danube river basin. The multilateral cooperation aiming at fulfilling these requirements is achieved within the International Commission for the Protection of the Danube River (ICPDR) headquartered in Vienna and the International Sava River Basin Commission headquartered in Zagreb, respectively. In addition to these international agreements, there are numerous other international agreements stipulating certain obligations of BiH, and as the European Union (EU) accession process moves forward, there will be increasingly larger number of requirements for alignment and harmonization of the national legal and institutional water management framework with the EU requirements and also for applying such standard requirements in practice.

By an analysis of the constitutional and legal framework of the Federation of BiH and its Cantons, certain specific qualities associated with the possibility of creating legal regulations for the water management issues in the Federation of BiH and its Cantons can be formulated. Namely, both the BiH Federation authorities and the Cantonal authorities are competent for regulating the policies of environmental protection and use of natural resources. Both the concept of environment and the concept of natural resources include water, and therefore, such a constitutional commitment of the Federation of BiH, which is consistently supported by corresponding provisions of the Cantonal constitutions, clearly indicates that the Federation of BiH and its Cantons share competences over these issues. This shared competence may be exercised collectively, individually, either by Cantons or through coordination, by the Federation authorities. In exercising these competences, the Federation authorities are bound by virtue of the Constitution to take into consideration the Cantonal competences, the different situations in different Cantons and the need for flexibility in implementation. The Federation authorities are entitled to set out the policies and adopt laws with respect to those competences that correspond to the Cantonal competences.

The water regulations of the Federation of BiH are adopted both at the BiH Federation level and at the Cantonal level, in accordance with the so defined constitutional framework.

3.1.2.2. Water Regulations of the Federation of BiH

The first Law on Waters of the Federation of BiH was adopted in 1998. Based on this law, several by-laws were adopted regulating certain number of issues that are vital for functioning of the water management system in the Federation of BiH (e.g. protection of water sources intended for human consumption, flood control, water protection, etc.). The effectiveness of certain number of previously adopted by-laws was extended until their amending by new by-laws adopted pursuant to this Law. The Law on Water Protection of the Federation of BiH was adopted in 2003. The second Law on Water of the Federation of BiH³⁴, superseding the 1998 Law on Water and the 2003 Law on Water Protection, was adopted in 2006. This Law stipulates adoption of a large number of by-laws³⁵, which is in progress.

This Law stipulates that the water management includes water protection, water use, protection against detrimental effects of water and regulation of watercourses and other waters. Among others, the issues associated with water property, water facilities, territorial water management, water management institutions, water management facilities, the role of the public in water management, financing of the water management system, etc.

In addition to the water rights regulations, legal standards regulating the water management system in the Federation of BiH are also contained in other regulations regulating other sectors. For example, these are the regulations on environmental protection, physical planning, forests, agricultural land, financial regulations, etc. Besides, as already stated, in the Federation of BiH, the issues associated with water are regulated in the Cantonal regulations as well, and for a successful water management, particularly, the cooperation is necessary, primarily with RS, being the other entity and with Brčko District. The cooperation with the neighbouring countries and wider international environment, in accordance with international agreements, progressively becomes a clearly defined solid framework within which the future BiH national water management system must be developed, especially bearing in mind the commitments arising from the EU Stabilisation and Association Agreement.³⁶

3.1.2.3. Some Characteristics of the New Water Management Legal and Institutional Framework in the Federation of BiH

After adopting the new Law on Water of the Federation of BiH in 2006, the process of structural change in the water management system of the Federation of BiH has commenced *de jure*. This system was developed and inherited from the earlier socialist era, when “water management” was regulated by the regulations applicable to the entire territory of the Socialist Republic of Bosnia and Herzegovina. The trend of these changes in the existing system has been reflected in the development of legal and institutional framework for water management based on the principles and in accordance with the requirements set out in the policies and laws of the European Union. The underlying instrument serving as the general paradigm based on the national system is developing is the *Water Framework Directive* (WFD), along with dozens of other EU regulations that should be taken into consideration. This is a process that must be implemented progressively, over a longer

³⁴ Official Gazette FBiH No. 70/06

³⁵ See the Table containing the LIST OF BY-LAWS THAT MUST BE ADOPTED IN ACCORDANCE WITH THE LAW ON WATERS OF THE FEDERATION OF BiH („Official Gazette of the Federation of BiH”, br. br. 70/06) attached as Schedule I.

³⁶ The Agreement was signed on 16 June 2008

period of time, simultaneously with the changes taking place in other segments of society, because this is an exceptionally complex management system, where the required changes are of such a character that they necessitate considerable financial investments that cannot be procured in a short period of time.

The Law on Water classifies all surface waters as Category I waters (in this case, the Federation of BiH is the owner of public water property for these waters) and Category II waters (in this case, the owner of public water property is either the city or the municipality, unless regulated otherwise by the Cantonal regulations). The Law regulates numerous issues that are traditionally regulated by water rights regulations, such as freedom to use water, water servitude, water structures, certain restrictions and limitations, etc.

The territorial water management, as stipulated in this Law, is defined within two river basin districts. The Sava River Basin District makes an integral part of the international Danube River Basin District (which is part of the international sub-basin /Sava river sub-basin) on the territory of BiH, i.e. the Federation of BiH. The Adriatic River Basin District encompasses parts of the international river basins: the Neretva River with Trebišnjica, the rivers Cetina and Krka on the territory of BiH, i.e. the Federation of BiH. Pursuant to this Law, *water management agencies* for these river basin districts have been established and headquartered in Sarajevo and Mostar, respectively. These agencies are by their nature public institutions and operate in accordance with the regulations stipulating the activities of the public institutions. They are the true successors of the previous public companies that used to operate in the river basin districts. In terms of their status, the water agencies represent an important qualitative progress in the organization of water management system, because they are not profit organizations. The agencies have their branch offices whose tasks are thoroughly regulated by the Law, such as management bodies and all other status issues, given the fact that in this case, the Law has the capacity of their charter of foundation. The Law sets out the obligation to establish a River Basin District Advisory Council, which is composed of the representatives of numerous stakeholders in the river basin districts.

The Law stipulates the obligation to adopt *Water Management Strategy* ("Strategy") defining, in the broadest sense, the water management policy of the Federation of BiH. The Strategy, upon the Government's proposal, is to be adopted by the Parliament of the Federation of BiH for the period of 12 years. The Water Management Strategy makes an integral part of Environmental Protection Strategy. For the purpose of implementation of the Water Management Strategy, the Law stipulates the obligation to adopt the water management plans for each of the river basin districts. The content of these plans is defined in accordance with the relevant requirements set out in the EU Water Framework Directive. The same applies to the programme of measures stipulating the main measures required for achieving the objectives with respect to water protection, water regulation and protection against detrimental effects of water and water use. Furthermore, the Law also defines the environmental protection objectives that must be ensured through implementation of the water plans and programmes. The role of the public in the planning processes is also defined in the Law.

Water use, water protection, regulation of watercourses and other waters and protection against adverse effects of water, being the traditional segments of water management activities, are regulated in detail in the separate sections of the Law, aiming at the continuation of the existing management resources. In the future, particularly the segment that is associated with the protection against detrimental effects of water should be subject to further transformation towards transposition and implementation of the EU Directive on Floods and Flood Management Concept Development in accordance with broader development trends in the area of protection against natural hazards (such as *Hyogo Framework*, for instance).

Separate sections of the Law regulate the issues that are associated with water information system, water deeds (such as preliminary water approval, water approval and water permit), regulating the rights of use and obligations in terms of water protection.

The water management system financing in the Federation of BiH is thoroughly regulated in this Law, and in this matter, the fact that is of vital importance is that the Law also stipulates the criterion for allocation of water charges and revenues generated by lease of public water property falling under Category I. Out of the total funds collected, the competent water agency receives 40%, while 45% is allocated to the Cantonal Budget and 15% is allocated to the Environment Protection Fund of the Federation of Bosnia and Herzegovina. The revenues generated by lease of the public water property falling under Category II surface waters are allocated to the respective Cantonal Budgets.

In the period since the adoption of the Law, calculating, collecting and control of the general and special water charges have proved to be a practical problem, because these tasks, pursuant to the water regulations, (i.e. a by-law adopted on the basis of the Law on Water) are put under the competence of the Tax Administration Office of the Federation of BiH. However, in accordance with the Law on Tax Administration Office of the Federation of BiH, the Tax Administration Office has no competences over the collection of fees, but only taxes, contributions and duties. For that reason there are initiatives to enforce the required amendments to the Law on Tax Administration Office of the Federation of Bosnia and Herzegovina, because only in this way, at this point of development, the water management system financing can be ensured in the Federation of BiH, and thus the continuity and suitable dynamics of the started system transformation and its getting closer to the desired model that would be capable of managing the waters of the Federation of BiH in accordance with the EU requirements. In addition, a clear regulation of this issue and elimination of this kind of obstacle to the engagement of the Tax Administration Office in these tasks, would make a significant contribution to a regular operation of the water management system and consequently, to the safety of citizens and material goods in the Federation of BiH.

3.1.2.4. Compliance of the BiH Federation Regulations with Community *Acquis*

All of the above-mentioned aspects of water management in the in the Federation of BiH must be regulated by the Law on Water and other regulations. A certain progress has been made with the 2006 Law on Water in terms of finding new modern management solutions that would accommodate the latest social requirements (among others, with respect to environmental protection, integrated water management, river basin water management respecting the ecosystem accessibility) as much as possible given the transitional capacities of the Federation of BiH. The initial review of the compliance of the provisions set out in this Law with the requirements of the four EU Directives shows that a high-level transposition of the requirements set out in several key EU Directives into the legal system of the Federation of BiH has been achieved. Further transposition of the EU requirements with respect to water management will follow upon adoption of the by-laws. Further analyses and assessments of the scope of this new Law and its by-laws, which are adopted for the purpose of the Law enforcement, will be developed simultaneously with the EU stabilization and association process developing. Accordingly, it is necessary to facilitate the flexibility of competent authorities and their responsiveness to the new proposals and amendments to the previously adopted arrangements leading to the full compliance of the water management system, in each of its (it should be noted: very complex) segments, with the European Union requirements within a controlled period of time.

3.1.3. Cantonal Water Laws

During the time of effectiveness of the 1998 Law on Water of the Federation of BiH, the Cantons adopted their first laws on water³⁷ and other water regulations falling under their competence.³⁸ In accordance with 2006 Law on Water, the Cantons are obliged to harmonize the provisions of the Cantonal laws on water with the provisions of the latest Law. This Law also stipulates the scope of authorizations granted to the Cantons with respect to regulating such issues by their own respective regulations. Namely, the Cantonal laws regulate the issues of organization and implementation of the activities that fall under the Cantonal competences in accordance with the Law on Water of the Federation of BiH. As no mechanism of coordination, and possibly verification and informing on the activities associated with this requirement for harmonizing the Cantonal water regulations is stipulated in the Law on Water of the Federation of BiH, it will be necessary, in the upcoming period, to legally regulate this obligation also, in order to ensure solid and efficient basis for coordination in adopting water regulations and their enforcement.

In terms of the Cantonal legislation related to waters, it would be necessary to emphasise the strategic importance of the commitment to divide the competences related to ensuring water intended for human consumption between the Federation of BiH and the Cantons in such a manner that FBiH is to adopt the regulations on the quality of water intended for human consumption and the regulations on effluents, while the development and legal regulation of the issues related to use and maintenance of the infrastructure for drinking water purposes and elimination of waste water should fall under the sole competence of the Cantons. The issue of public-private partnership in management of these infrastructure facilities is the issue that will become increasingly important in the upcoming period and must be given great attention at the level of the Federation of BiH in order to achieve the relevant policy objectives in the way that they ensure equal position of all citizens in the Federation of BiH, and in coordination with the authorities of Republika Srpska and Brčko District – all citizens of BiH.

In this context, the issue of water concessions is unavoidable. Harmonization of the competences and regulations associated with water concessions between the Federation of BiH and the Cantons is necessary in order to avoid negative consequences for water resources and public infrastructure, which have been noticed in the past, especially when it comes to inter-sectoral issues, such as, for instance, the issue of hydro power plants construction. In any case, the inter-sectoral (interdepartmental) harmonization, in addition to the harmonization of the above-mentioned issues between the Federation of BiH and the Cantons, needs to be ensured through, *inter alia*, a consistent and timely application of the environmental management tools, such as Environmental Impact Assessment and Strategic Impact Assessment. In addition to the authorities competent for water management, the authorities competent for environmental protection, both at the BiH Federation level and at the Cantonal level, must also be given an opportunity to influence the decision-making in all water concession awarding procedures, i.e. they have to be given an opportunity to protect the interests of the resources for which they are competent by virtue of law.

3.1.4. Entity Relations

So far, the relations between the entities, in different spheres of life, have been relatively often regulated by specific legal instruments – Memoranda of Understanding. However, this practice,

³⁷ For more details, see the Table in Appendix I.

³⁸ Such as the law on Proclaiming the water reservoir „Modrac“ for the drinking water source and the protection of water reservoir and river basin („Official Gazette of Tuzla Canton“, No. 05/06)

although it is not contrary to the constitutional norms, has not been particularly supported in official circles as a model for regulating open inter-entity issues. Besides, the memorandum of understanding to the extent it has been used as a legal instrument in the practice of executive authorities has never evolved to be ratified by the parliaments (either at entity, district or state level), which would give it statutory effect. Cases of signing the memoranda of understanding between the state authorities and entity authorities and the District, which would regulate the coordination of exercising certain competences associated with water, have not been recorded so far.

In the water sector, the memoranda of understanding have been signed so far between the two entity governments, between the entity ministers responsible for water, and between the entity governments and the EU Commission. The intention here was to facilitate the management of BiH water resources in a harmonized manner by regulating the issues of inter-entity cooperation with respect to the shared water resources.

The Memorandum of Understanding between the Federation of Bosnia and Herzegovina and Republika Srpska regarding water issues was signed in 1998 by entity governments, recognizing the need for establishing the mechanism of inter-entity cooperation in the area of water and the need of informing the institutions of Bosnia and Herzegovina on the activities in the area of international cooperation in terms of trans-boundary watercourses. By this Memorandum, the Inter-entity Coordination Commission has been established, and its scope of work and the terms and conditions of its operation were defined. The Commission makes its decisions by consensus and in case that the consensus decision-making is not possible, a mechanism for resolving disputable situations will be applied. The issues that fall under the competences of the Commission include: (i) international agreements on water management issues from the aspect of environmental protection; (ii) international watercourses; (iii) international projects; (iv) cooperation with neighbouring countries; (v) harmonization of the existing and future water regulations; (vi) harmonization and monitoring of the quality standards; (vii) harmonization and control of operations of the laboratories for water quality monitoring and watercourses categorization; (viii) construction and reconstruction of water management facilities at the inter-entity border line and in its proximity; (ix) harmonization of water management plans for the facilities intersected by the inter-entity border line; (x) collection and exchange of data; (xi) harmonization of plans related to flood control and other extraordinary situations.

The Commission is obliged to make sure that the interests of both entities are taken into consideration when planning water use, in particularly in the cases of opposed interests. The Memorandum of Understanding, which was signed in late 2000 between the Government of the Federation of Bosnia and Herzegovina and the Government of Republika Srpska on one side, and the European Community Commission on the other, demonstrates the political will of all parties for providing a sustained support to the institutional reforms in the BiH water sector focused on adopting beneficial, enforceable and transparent regulations based on the river basin concept and compliant with the European Union regulations and international conventions. This Memorandum of Understanding made the basis for ensuring international donor support to the implementation of the BiH water sector institutional strengthening project whose implementation eventually resulted in the adoption of the 2006 Law on Water of the Federation of BiH.

The Ministry of Agriculture, Water Management and Forestry of the Federation of BiH and the Ministry of Agriculture, Forestry and Water Management of Republika Srpska signed in 2001 the Memorandum of Cooperation making a binding commitment to future cooperation in, *inter alia*, the water sector. Among other things, the Memorandum stipulates that the Ministries are to strengthen

their cooperation with the Inter-entity Water Management Commission and to provide it full support through a comprehensive implementation of the existing Memorandum on Cooperation and the coordination of water management-related issues. It is also stipulated that these two Ministries are to harmonize the regulations and synchronize the organization of the enforcement and control of water protection, especially flood control and incidental pollutions, and to jointly develop a document specifying the procedure for issuing water management deeds (terms and conditions, approvals and permits) for the facilities situated on the shared watercourses, i.e. for the facilities situated in the areas between the two entities. This document demonstrates the will of these two ministries for achieving the full cooperation in implementation of the Memorandum of Understanding and implementation of the water sector institutional strengthening in BiH and the cooperation in terms of other issues falling under the competences of the Ministries. In this matter, it has been envisaged that the competent departments subsequently agree on the time schedule for implementation of the obligations set out in the Memorandum. (This time schedule has never been made).

The regulation of inter-entity relations in this manner has proven to be insufficiently effective so far, which is actually understandable, taking into account the legal character of the instrument (Memorandum of Understanding) used for regulating these relations. Namely, these instruments can be rather considered the instruments of policy or, in the best case, the instruments of soft law, used for expressing political will to regulate certain issues in a certain way, within a certain framework. However, the obligations assumed in this manner have no character of the obligations assumed by virtue of agreement or prescribed by the law. Accordingly, any failure to comply or observe the provisions of the Memorandum of Understanding does not involve accountability in the form in which it arises in case of failure to comply or observe contractual obligations or in case of breach or violation of law.

In this light, the absence of effects expected from signing the inter-entity Memoranda of Understanding (at the level of entity governments, as subsequently, between the Ministers) should be perceived and interpreted as a considerable achievement in terms of harmonization of the entity water regulations, but also as the fact that according to the available information, the inter-entity commission for coordination of issues in the area of water management has not met for years and practically does not serve the purpose for which it was originally established and for which the Memorandum of Understanding between the entity governments was signed.

The Law on Water of the Federation of BiH contains several provisions aiming at overcoming the problems that are arising or are likely to arise in management of the water resources shared between the two entities and the District. These provisions are based on the commitment to ensure parity and equity for all citizens and business entities in Bosnia and Herzegovina, when it comes to water, through regulations and their enforcement. This implies adopting numerous regulations (by-laws) with similar, synchronized arrangements that would be applicable to the entire territory of Bosnia and Herzegovina. In this sense, in several cases, especially when it comes to adoption of the by-laws ensuring transposition of EU regulations into the BiH legal system, the BiH Council of Ministers is given a possibility to adopt certain by-laws, while the Government of the Federation of BiH is obliged to adopt such by-laws only in case that the Council of Ministers fails to do so. In numerous other cases, the Government of the Federation of BiH is obliged to adopt certain by-laws in consultations with the Government of Republika Srpska. This legal obligation of the Government of the Federation of BiH is supplemented with the legal obligation of the water agency to „participate in the coordination of the drafting and implementation of water management plans together with the competent organizations from the Republic of Srpska at the level of Bosnia and Herzegovina, or with authorities competent for the region of the international sub-basin of the River

Sava and the international river basins of the Neretva and Cetina rivers “ (Article 156, paragraph 1, item 13). In accordance with the legal obligation of the River Basin District Advisory Council to “review and comment on water management issues of relevance to inter-entity cooperation, to Bosnia and Herzegovina as a whole and the international commitments of Bosnia and Herzegovina“ (Article 165, paragraph 1, item 5), the Council is also obliged to make it possible for representatives of the River Basin District Agency for the same river basin district in the Republic of Srpska to attend the meetings of the Council (Article 166, paragraph 4).

The legal regulation of such an approach in the Federation of BiH has been ensured in cooperation with the authorities of Republika Srpska during the drafting process of the 2006 Draft Law on Water. However, it must be stated that regrettably, at the time of adoption of the 2006 Law on Water of Republika Srpska, the approach according to which certain regulations would be adopted in Republika Srpska only in case that the BiH Council of Ministers fails to do so, i.e. the approach according to which the Government of Republika Srpska would be obliged to consult the Government of the Federation of FBiH when adopting by-laws was omitted. This Law introduces a less binding arrangement of the inter-entity cooperation, because the water agency was assigned the obligation to „participate in cooperation related to the issues of coordination associated with drafting, developing and implementing the integral water management plans with the corresponding organizations in the Federation of BiH for the needs of Bosnia and Herzegovina, and the international bodies competent for international river basin districts “ (Article 178, paragraph 1, item g) and „to set out the procedures for regular consultations with the corresponding agency on the territory of Republika Srpska and the Federation of BiH “ with respect to performing tasks of the agency set out in this Article (Article 178, paragraph 1, item h). In addition, Article 185, paragraph 1, item 6, stipulates that the River Basin District Council „reviews and provides recommendations on any issue within the water sector and being of relevance for BiH, inter-entity cooperation or international commitments“ (Article 185), and that the Council will „ provide, when necessary, the representatives of the corresponding water agency from the other entity with the possibility to attend the meetings“(Article 186, paragraph 4).

All of the above-stated indicates that there is a need of constantly putting an effort towards improvement and upgrading the inter-entity cooperation. As the country approaches the European Union and thus facing increasingly more complex requirements, this need will become increasingly more evident and it can be expected that satisfactory solutions will be found in the future.

No.	Legal basis	Title	Deadline for adoption	Competence for adoption	Sponsor
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3.1.5. Appendices

LIST OF BY-LAWS REQUIRED UNDER THE LAW ON WATER OF THE FEDERATION OF BiH (Official Gazette of FBiH, No. 70/06)³⁹

1	Article 43, paragraph 1, item 1) (with reference to Article 31.)	Methodology for identification of surface water body types and characterization of surface water and groundwater bodies	2 years after the date of entry into force of the Law on Water (Article 219, paragraph 1)	FBiH Government	The Government of the Federation is to adopt these regulations under condition that the BiH Council of Ministers fails to do so (Article 43, paragraph 2). Before adopting these regulations, the Government of the Federation shall in consultations with the Government of Republika Srpska ensure their harmonization with the corresponding regulation of Republika Srpska (Article 43, paragraph 3)
2	Article 43, paragraph 1, item 2) (with reference to Article 32.)	Reference conditions for classification of ecological status and emission limit values of the chemical quality parameters for chemical condition classification of surface water body		Federal Ministry	
3	Article 43, paragraph 1, item 3) (with reference to Article 32.)	Parameters of quantity and chemical quality for classification of the groundwater body status			
4	Article 43, paragraph 1, item 4	Procedure for implementation of economic analysis of water use			
5	Article 43, paragraph 1, item 5) (with reference to Articles 32-37)	Establishment of the environmental objectives			

³⁹ For the purpose of this Appendix, the term "Federal Ministry" means the Ministry of Agriculture, Water Management and Forestry of the Federation of BiH, and the term "Federal Minister" means the Minister of Agriculture, Water Management and Forestry of the Federation of BiH

No.	Legal basis	Title	Deadline for adoption	Competence for adoption	Sponsor
6	Article 43, paragraph 1, item 6)	Monitoring and monitoring programme contents			
7	Article 25, paragraph 4	Detailed contents and procedure for adopting water management plans of river basins in the Sava River Basin District and the Adriatic River Basin District	2 years after the date of entry into force of the Law on Water (Article 219, paragraph 1)	The Government of the Federation, following the proposal of the Federal BiH with respect to the issues falling under the BiH competences	
8	Article 23, paragraph 5	Decision on the boundaries of the river basin districts and river basins on the territory of the Federation of Bosnia and Herzegovina („Official Gazette of FBiH“, No. 41/07)			Following the proposal of the Federal minister
9	Article 164, paragraph 3	Charter of Foundation of the Advisory Council		Government	
10	Article 164, paragraph 5	Deed on the type and amount of costs of the advisory council	6 months after the date of entry into force of the Law on Water (Article 219, paragraph 2, item 1)		Federal minister and Federal minister of environment, with prior approval of the Federal Minister of Finance
11	Article 171. (with reference to Article 170.)	Resolution on the amount of special water charges („Official Gazette of FBiH“, No. 47/07)			Following the proposal of the Federal Minister and the Federal minister of environment
12	Article 173, paragraph 7	By-law defining terms and conditions for exemption from special water charge specifying in detail the terms and conditions, procedures, deadlines and measures in cases of failure to meet the obligations of reducing pollutant emissions	1 year	Government	

No.	Legal basis	Title	Deadline for adoption	Competence for adoption	Sponsor
13	Article 55, paragraph 1	By-law on emission limit values of pollutants in the waste water and other requirements associated with waste water discharge into surface waters and indirect waste water discharge into groundwater		Government Government, in case that the BiH Council of Ministers fails to adopt this regulation. Before adopting these regulations, the Government of the Federation shall in consultations with the Government of Republika Srpska ensure their harmonization with the corresponding regulation of Republika Srpska	Federal Minister of Environment
14	Article 55, paragraph 1	By-law on hazardous and priority substances	2 years		Federal Minister of Environment
15	Article 55, paragraph 4	By-law on stricter conditions than those which would result from the application of Article 55, paragraph 1		Cantonal government	
17	Article 57, paragraph 1	By-law on identifying individual surface water or parts thereof where the navigation of vessels using oil derivatives as a motor fuel is prohibited		Federation Government	Federal Minister
18	Article 107, paragraph 4	By-law on contents, form, terms and conditions, issuing, maintaining and other issues of importance for water deeds (preliminary water approval, water approval, water permit)			
19	Article 120, paragraph 6	Rulebook on requirements and criteria that must be fulfilled by a person registered for development of the documents to be submitted with the application for issuing a water deed („Official Gazette of FBiH“, No. 17/08)	6 months	Federal minister	
20	Article 174, paragraph 1.	Rulebook on calculating, procedure and deadlines for calculating, paying and controlling the settlement of the liabilities arising from the general water charge and the special water charges („Official Gazette of FBiH“, No. 92/07)		Federal minister in cooperation with the Federal Minister of Finance	

No.	Legal basis	Title	Deadline for adoption	Competence for adoption	Sponsor
21	Article 10, paragraph 4, (with reference to paragraph 3)	By-law on terms and conditions of the limited right to use a public water property that cannot be subject to traffic, but that can be, under certain conditions and in accordance with water regulations subject to limited right of use in the form of lease			
22	Article 50. Paragraph 2, (with reference to paragraph 1)	By-law on contents and manner of keeping records and delivering data on abstraction of water, save for the general use of water by legal and physical entities	1 year		
23	Article 104.	By-law on establishment and management of WIS (water information system)		Federal minister	
24	Article 64. Paragraph 5, (with reference to paragraph 1)	By-law on requirements that must be met by a reference laboratory i.e. a laboratory authorized for monitoring of water status, verification of the results produced by an authorized laboratory and for carrying out the tasks falling under the competences of the Federal ministry, Federal ministry competent for environment, Cantonal ministries competent for water and environment and the water agency and on the contents and granting authorizations for the laboratory operations	2 years		
25	Article 66, paragraph 3, (with reference to paragraph 1)	By-law on determining the terms and conditions for identifying the sanitary protection zones and protection measures for water sources that by virtue of their quantity and quality may be used or are being used in public water supply systems, which must be protected against pollution and other adverse effects on quality of drinking water or the source yield		Federal minister in cooperation with Federal ministers of health and environment	
26	Article 86, paragraph 4.	By-law on identifying the area threatened by floods and erosions of surface waters and categorization of soil into threat categories	2 years	Federal Minister	

No.	Legal basis	Title	Deadline for adoption	Competence for adoption	Sponsor
27	Article 90, paragraph 3. (with reference to paragraph 1)	By-law on types and contents of special plans for flood and ice control, plans for protection against erosions and torrents and plans for protection against extraordinary water pollution		Government	Following the proposal of the Federal minister (Article 220, paragraph 3, mistakenly stipulates that this regulation is to be adopted by the Federal minister)
28	Article 59, paragraph 3 (with reference to paragraph 1)	By-law on special conditions for production, handling and keeping hazardous substances and waste, for the purpose of defence and other similar purposes, exempt from Article 59, paragraph 1 that prohibits production, handling, keeping and disposing hazardous substances and waste in waters and water property		Federal minister competent for environment	
29	Article 61, paragraph 9	By-law on procedures and measures to be taken in case of accident	1 year	Federal minister competent for environment together with the Federal Minister	
30	Article 73	By-law on identifying susceptible and less susceptible areas and measures of protection, prohibition and restriction in a susceptible area		Federal minister competent for environment in agreement with the Federal Minister	
31	Article 74, paragraph 1.	By-law on proclamation of susceptible areas on the territory of the Federation of Bosnia and Herzegovina	1 year	Federal minister competent for environment	
32	Article 74, paragraph 2.	By-law on proclamation of susceptible areas stretched on the territory of the Federation of Bosnia and Herzegovina and Republika Srpska		Ministry of BiH competent for water	Ministers of the Federation and Republika Srpska competent for water and environment
33.	Article 76, paragraph 2.	By-law on proclamation of susceptible areas stretched on the territory of Bosnia and Herzegovina and a neighbouring country		BiH authority specified in the BiH regulation	

No.	Legal basis	Title	Deadline for adoption	Competence for adoption	Sponsor
34	Article 76, paragraph 2. (with reference to paragraph 1)	By-law on mandatory water monitoring and activities in susceptible areas	1 year	Federal minister competent for environment , in agreement with the Federal minister	
LIST OF BY-LAWS REGULATING CERTAIN ISSUES ASSOCIATED WITH WATER⁴⁰ ARISING FROM THE PROVISIONS OF OTHER LAWS					
35	Article 17, paragraph 1. and Article 115, paragraph 2	Amendments to the resolution on identifying the Una river basin as the area of relevance for the Federation of Bosnia and Herzegovina („Official Gazette of FBiH“, No. 80/07) [Law on Physical Planning and Use of Land at the level of Federation of BiH („Official Gazette of FBiH“, No. 2/06 and 72/07)]		FBiH Parliament	Upon proposal of the Government of the Federation of BiH
36	Articles 35 and 41	Resolution on adopting the Funds Allocation Programme as set out in the 2007 Budget of the Federation of Bosnia and Herzegovina with criteria for allocation of the funds positioned under “Capital Water Management Grant”[Law on Execution of 2007 Budget of the Federation of Bosnia and Herzegovina („Official Gazette of FBiH“, No. 25/07), with reference to Article 210, paragraph 2 of the law on Water („Official Gazette of FBiH“, No. 18/98)]		Government of the Federation of BiH	Upon proposal of the Ministry of Agriculture, Forestry and Water Management
37	Article 7	Amendments to the Rulebook on method of payment of public revenues to the budget and off-budget funds on the territory of the Federation of BiH („Official Gazette of FBiH“, No. 28/08) [Law on entitlement to the public revenue in the Federation of BiH („Official Gazette of FBiH“, No. 22/06)]			

⁴⁰ There is no doubt that certain issues related to waters are also subject to by-laws adopted on the basis of other regulations (for instance, the regulations on physical planning, environment protection, etc.); however, there is no need for this issue to be presented so extensively. This Strategy outlines only the system of legislation (primary and secondary) related to waters and as an example, in this case, only several acts are mentioned to enable insight into the manner of linking the water legislation with other (horizontal and sectoral) systems and regulations within the legal system of the Federation of BiH.

**LIST OF BY-LAWS
ADOPTED PURSUANT TO THE 1998 LAW ON WATER**

No.	Legal basis	Title	Deadline for adoption	Competence for adoption	Sponsor
38	Article 93	Decree on flood control plans („Official Gazette of FBiH“, No. 03/02)			
39	Article 31, paragraph 6.	Rulebook on minimum contents of the general act on maintenance, utilization and observation of water management facilities („Official Gazette of FBiH“, No. 49/01) [A Rulebook under the same title, adopted under the same provision of the 1998 Law on Water, but with different text was posted on the <i>web site</i> of the Federal ministry under reference number 05-25-10-1/07 dated 6 March 2007]			
40	Article 39, paragraph 4	Rulebook on contents, form, terms and conditions of issuing and maintaining water management deeds („Official Gazette of FBiH“, No. 03/02)			
41	Article 117, paragraph 6	Rulebook on requirements for determining the sanitary protection zones and protection measures for water sources that are used or intended to be used for drinking („Official Gazette of FBiH“, No. 51/02)			
42	Article 93	Resolution n Master Plan of the operative measures for flood control in 2007 (1 February 2007) [The legal basis here is Article 9, paragraph 1 of the Decree on flood control plans („Official Gazette of FBiH“, No. 03/02), adopted pursuant to the 1998 Law on Water]			
44	Article 117, paragraph 9, with reference to Article 5, item 12	Rulebook on protection ones and protection measures of the source „Okanovići“ for water supply of Gradacac (6 February 2007) [The legal basis here is Article 43, paragraph 1 of the Rulebook on requirements for determining the sanitary protection zones and protection measures for water sources that are used or intended to be used for drinking („Official Gazette of FBiH“, No. 51/02)]			

No.	Legal basis	Title	Deadline for adoption	Competence for adoption	Sponsor
45	Article 124, paragraph 1, item 1	Rulebook on emission limit values of hazardous and harmful substances for industrial waste water before their discharging into public sewage system, or other recipient („Official Gazette of FBiH“, No. 50/07)			
46	Article 124, paragraph 1, Item 2	Rulebook on emission limit values of hazardous and harmful substances for industrial waste water that is after treatment discharged into a natural recipient through public sewage system („Official Gazette of FBiH“, No. 50/07)			

LIST OF ADOPTED CANTONAL WATER BY-LAWS

1	Tuzla Canton	Law on Water	„Official Gazette of Tuzla Canton “, No. 15/99
2	Tuzla Canton	Law on proclamation of the Modrac Reservoir as the source of drinking water, protection of accumulation and the river basin: „Law on Protection of the Modrac Accumulation”	„ Official Gazette of Tuzla Canton “, No. 05/06
2	Zenica-Doboj Canton	Law on Water	„ Official Gazette of Zenica-Doboj Canton “, No. 8/00
3	Sarajevo Canton	Law on Water	„ Official Gazette of Sarajevo Canton “, No. 16/00
4.	Middle Bosnia Canton	Law on Water	„ Official Gazette of Middle Bosnia Canton “, No. 14/02
5	Posavina Canton	Law on Water	„ Official Gazette of Posavina Canton “, No. 02/00

3.2. Water Management Institutional Framework in the Federation of BiH



3.2.1. Introduction

The Law on Water of the Federation of BiH⁴¹ (Article 21) states that *water management shall be the competence of Bosnia and Herzegovina, the Federation, cantons, towns and municipalities*. The Entity Laws on Water set out the institutional framework for the water management sector. These laws, whose procedure of drafting and adopting lasted several years, have been created in compliance with the water resources management approach used in the EU Member States, in a spirit of the BiH approximation to the membership in this organization. The laws on water set out a new water management structure,

so that the basic management unit is *District*.

In the Federation of BiH, this includes the Sava River Basin District and the Adriatic River Basin District. Organizationally, for the purpose of implementation of water management tasks, the Law on Water stipulates the establishment of the water agencies, as follows: *The Sava River Basin District Agency* (the Sava RBD Agency) and *the Adriatic Sea River Basin District Agency* (the Adriatic Sea RBD Agency), headquartered in Sarajevo and Mostar, respectively.

In addition to the water agencies, the Law also stipulates establishment of *branch offices*, for the purpose of more efficient implementation of tasks and the promotion of principles in order to achieve better contact with water consumers. The intention is to establish and attach to the Sava RBD Agency the branch offices for the Una River sub-basin in Bihać, the Vrbas river sub-basin in Jajce, the Bosna river sub-basin in Zenica and the Drina river sub-basin in Goražde. The branch offices attached to The Adriatic Sea RBD Agency would be established in Livno for the Cetina and Krka rivers basin and in Konjic for upper course of the river Neretva, with the river Rakitnica and for the middle lake-side course of the river Neretva. In the previous period, during the process of institutionalization of the water sector in BiH and the Federation of BiH, the branch offices in Zenica and Jajce were established for the Sava River Basin District and the branch office for the rivers Cetina and Krka was established in Livno, and for upper part of r. Neretva, in town of Konjic.

The graph below shows the institutional organization chart of the water sector in BiH, with emphasis on the Federation of BiH.

⁴¹ Official Gazette FBiH No. 70/06

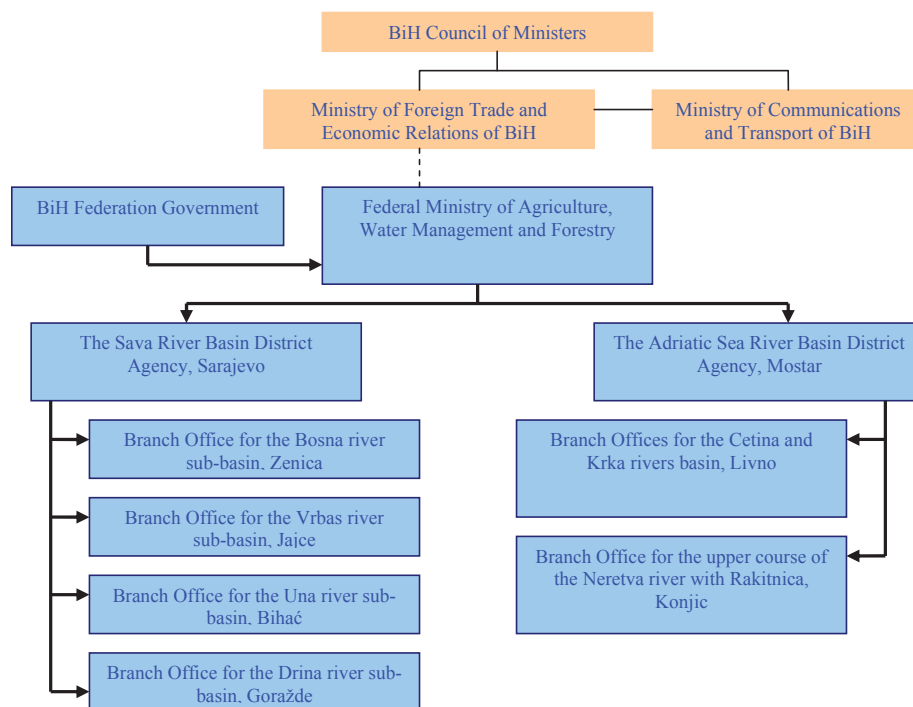


Figure 3.2.1: Institutional and legal framework for water management sector in BiH and the Federation of BiH

3.2.2. Federal Ministry of Agriculture, Water Management and Forestry

The Federal Ministry of Agriculture, Water Management and Forestry (the Ministry) has been established pursuant to the Law on Federal Ministries⁴², and Article 15 of this Law describes the general competence of this Ministry: [The Ministry] *performs administrative, technical and other tasks stipulated in the Law that fall under the competences of the Federation in the area of agriculture, water management and forestry*. The Ministry is headquartered in Sarajevo, and the water management tasks within this Ministry are assigned to the „Water Management Sector“. The activities of the Ministry are related to water resources development plans, water balances, water use, protection of water, protection against water, and other tasks stipulated in the Law on Federal Ministries.

Organizationally, the Ministry is divided into the following sectors⁴³: (i) Agriculture Sector, (ii) Agriculture Policy and International Cooperation Sector, (iii) Food Industry Sector, (iv) Water Management Sector, (v) Veterinary Sector and (vi) Forestry Sector.

The activity of the Ministry and the water sector in the Federation of BiH, after defining the institutional organization, has been described in the Law on Water. In addition to this underlying

⁴² Official Gazette FBiH No .8/95

⁴³ In accordance with the Rulebook on Internal Organization of the Federal Ministry of Agriculture, Water Management and Forestry

piece of legislation, the water management sector is more or less associated with the Law on Environmental Protection and the Law on Environment Protection Fund⁴⁴.

3.2.3. International Water Management Framework

The international water management framework for the Federation of BiH is consisted of the international agreements that Bosnia and Herzegovina signed and assumed from the previous period, as well as the signed conventions and agreements covering this area.

Because of their position, internal legal arrangements and international environment, Bosnia and Herzegovina and the Federation of Bosnia and Herzegovina are inclined to international cooperation in the area of water management, primarily with the neighbouring countries in the region. The internal organization of the country requires that the foreign policy affairs related to this sector are pursued thorough the institutions of the State of Bosnia and Herzegovina (i.e. the Ministry of Foreign Trade and Economic Relations), however, the implementation of the assumed obligations is the obligation of the entities.

Given the fact that the territories of Bosnia and Herzegovina and the Federation of Bosnia and Herzegovina belong to the Danube river basin and the Adriatic Sea basin, the international cooperation framework has been established on this basis and spread through the Convention on Cooperation for the Protection and Sustainable Use of the River Danube (Danube River Protection Convention) and the Convention for the Protection of the Mediterranean Sea against Pollution (Barcelona Convention).

The regional cooperation between the countries gravitating to the Sava River has been defined in the *Framework Agreement of the Sava River Basin*,⁴⁵ setting out: (i) the establishment of the international navigation regime; (ii) the establishment of the sustainable water management; (iii) taking measures for the purpose of preventing and limiting adverse effects of water; and (iv) establishment of mechanisms for creating an efficient multilateral cooperation between the countries of the Sava River sub-basin.

The bilateral relations with the neighbouring Republic of Croatia in the area of water management are stipulated in a separate document – *the Treaty between the Government of the Republic of Croatia and the Government of Bosnia and Herzegovina on the establishment of water management relations*⁴⁶ regulating the water sector relations of common interest for the two countries based on the Convention on the protection and use of trans-boundary watercourses and international lakes (Helsinki Convention).

The European integration process of the BiH involves assuming a range of obligations and rules in the water management sector. *The Water Framework Directive (WFD)*⁴⁷ is, certainly, the main document for this sector.

⁴⁴ Official Gazette FBiH No.33/03

⁴⁵ „Framework Agreement of the Sava River Basin“, Official Gazette of BiH br.8/2003 – International Agreements

⁴⁶ Official Gazette of RBiH, special edition – International Agreements, No. 6, dated December 25, 2006

⁴⁷ Directive 2000/60/EC of the European Parliament and of the Council of 23 october 2000 establishing a framework for the Community action in the field of water policy (Water Framework Directive).

3.2.4. Professional institutions at the Level of the Federation of Bosnia and Herzegovina

Pursuant to the Law on Water, Article 152, the *River Basin District Agencies*, having the capacity of the professional institutions have been established „for the purpose of implementing water management tasks“, as follows: the Sava River Basin District Agency (Sava RBD Agency) headquartered in Sarajevo (www.voda.ba) and the *Adriatic Sea River Basin District Agency* (The Adriatic Sea RBD Agency) headquartered in Mostar (www.jadran.ba).⁴⁸

Within the framework of the institutions of the Federation of BiH, in addition to the above-mentioned agencies, the water sector is by nature of its activities and competences, associated with the following professional institutions:

- Federal Hydrometeorological Institute, Sarajevo (www.fhmzbih.ba);
- Federal Institute for Agropedology, Sarajevo,
- Federal Institute for Geology, Sarajevo (www.fzzg.ba);
- Federal Administration for Geodetic and Real Property Affairs, Sarajevo (www.fgu.com.ba);
- Agency for Statistics of Bosnia and Herzegovina, Sarajevo (www.bhas.ba/new/);
- Federal Office of Statistics, Sarajevo (www.fzs.ba);
- Federal Administration of Civil Protection, Sarajevo (www.fbihvlada.gov.ba/fucz/).

Naturally, the water management sector is also associated with numerous, domestic and foreign consulting companies operating on the territory of the Federation of BiH.⁴⁹

3.2.5. Cantonal Ministries Competent for Water Management Sector

In the Federation of BiH, in addition to the Federal one, the Cantonal ministries competent for this sector are also involved in water management:

- *Una Sana Canton*, Cantonal Ministry of Agriculture, Water Management and Forestry, (www.vladausk.ba);
- *Posavina Canton*, the Ministry of Agriculture, Water Management and Forestry, Water Management Sector (www.zupanijaposavska.ba);
- *Tuzla Canton*, the Ministry of Agriculture, Water Management and Forestry (www.vladatk.kim.ba);
- *Zenica Doboј Canton*, the Ministry of Agriculture, Water Management and Forestry, Water management and Forestry Sector (www.zdk.ba);
- *Bosnian Podrinje Canton*, the Cantonal Ministry of Economy (www.bpkgo.ba);
- *Middle Bosnia Canton*, the Ministry of Forestry, Water Management and Agriculture, with Water Management Department assigned to carry out the water sector-related tasks on the territory of the Canton, (www.sbk-ksb.gov.ba);

⁴⁸ The competences and tasks of the River Basin District Agencies are also defined in the Law on Water, Article 155 and Article 156.

⁴⁹ Following the public invitation, the Federal Ministry of Agriculture, Water Management and Forestry published the list of Legal Entities that received the Authorizations for complex water facilities or activities. The list includes the following Legal Entities: Javno preduzeće za vodoprivrednu djelatnost Spreča d.d. Tuzla; Zavod za vodoprivredu d.d. Sarajevo; ES Hydrotechnics d.o.o. Sarajevo; Privredno društvo Institut za hidrotehniku GF Sarajevo d.d. Sarajevo; Ipsa institut d.o.o. Sarajevo; Vodovod d.o.o. Mostar i Energoinvest d.d. Sarajevo. In addition to this one, the list of Legal Entities that received the Authorizations for less complex water facilities and activities was published: Zavod za vodoprivredu d.o.o. Mostar and Tehnograd Tuzla. (Source: Web Site of the Ministry, July 2009).

- *Herzegovina Neretva Canton*, the Ministry of Agriculture, Forestry and Water Management (www.vlada-hnz-k.ba);
- *West Herzegovina Canton*, the Ministry of Physical Planning, Resources and Environment, (www.vladazzh.com);
- *Sarajevo Canton*, the Ministry of Economy, Sector for Agriculture, Water Management and Forestry (www.privreda@ks.gov.ba)⁵⁰;
- *Livno Canton*, the Ministry of Agriculture, Water Management and Forestry (www.vladahbz.com).

The competences for the water management are mainly attached to the Cantonal ministries of agriculture, water management and forestry, similar to the Federal level, while in some cases these competences are attached to the ministries of economy. The general competences of the Cantonal ministries for water sector, regardless of whether they have separate departments and sectors or not, are: (i) Protection of water and protection against water and regulation of the water regimens; (ii) Flood, erosion and torrent control; (iii) Public water supply and use of water for business purposes; (iv) Agricultural drainage and (v) Planning of the water sector development.

3.2.6. Personnel Structure – Human Resources in the Water Sector⁵¹

The human resources, i.e. the skilled personnel in the water sector in the Federation of BiH have been analyzed by institution within the Federal and Cantonal ministries, as well as at the level of professional institutions. In the Ministry of Agriculture, Water Management and Forestry of FBiH, „the water management sector“⁵², employs 5, out of the 8 designated management personnel positions, while out of the 5 designated associate positions, 3 are filled.

An illustrative outline of the skilled personnel for the position of Cantonal Assistant Minister and the position of Associate competent for water management is provided in the table below:

⁵⁰ At Sarajevo Canton, responsible ministry for all public companies is Ministry for Spatial Planning and Environment Protection. This ministry is responsible for financing a part of public companies activities.

⁵¹ Data dating back in June 2008

⁵² According to the organizational structure of the water management sector and pursuant to the Rulebook on Internal Organization of the Ministry of Agriculture, Water Management and Forestry of FBiH

Skilled personnel in the Cantonal ministries responsible for water management			
No.	Canton/Ministry	Assistant Ministers and management personnel Associates and inspectors responsible for the water sector	
		Current status	Designated
1.	Una Sana Canton (Canton 1)	2	5
	Ministry of Agriculture, Water Management and Forestry		
2.	Posavina Canton (Canton 2)	3	7
	Ministry of Agriculture, Water Management and Forestry		
3.	Tuzla Canton (Canton 3)	7	8
	Ministry of Agriculture, Water Management and Forestry		
4.	Zenica Dobo Canton (Canton 4)	4	7
	Ministry of Agriculture, Water Management and Forestry		
5.	Bosnian Podrinje Canton (Canton 5)	2	3
	Ministry of Economy		
6.	Middle Bosnia Canton (Canton 6)	2	5
	Ministry of Forestry, Water Management and Agriculture		
7.	Herzegovina Neretva Canton (Canton 7)	4	10
	Ministry of Agriculture, Forestry and Water Management		
8.	West Herzegovina Canton (Canton 8)	2	4
	Ministry of Economy		
9.	Sarajevo Canton (Canton 9)	4	5
	Ministry of Economy. Sector for Agriculture, Water Management and Forestry		
10.	Canton 10	0	3
	Ministry of Agriculture, Water Management and Forestry		
TOTAL:		30	57

Table 3.2.1. Skilled Personnel in the Cantonal Ministries responsible for the water management

The personnel structure status in the professional institutions at the level of the Federation of BiH is as follows:

Professional Institution	Technical Personnel according to the job systematization	
	Current status	Designated
The Sava River Basin District Agency ⁵³	37	58
The Adriatic Sea River Basin District Agency ⁵⁴	20	37
Federal Hydrometeorological Institute Sarajevo ⁵⁵	6	11
Federal institute for Agropedology Sarajevo	10	31
Federal Institute for Geology Sarajevo	18	29
TOTAL:	91	166

Table 3.2.2. Personnel in the professional institutions

⁵³ According to the Rulebook on internal organization and systematization of jobs, the Sava RBD Agency, Sarajevo, May 2008.

⁵⁴ According to the Outline of the positions and employees, the Adriatic Sea RBD Agency, Mostar, 7 April 2008.

⁵⁵ This institution includes the following positions: director and the personnel of hydrology sector and the personnel of environment sector – Water Quality Department

3.2.6.1. Status Analysis

As presented above, the water sector human resources in Federal and Cantonal ministries, as well as those in the professional institutions, are insufficient for fulfilling all of the tasks required. An illustrative example is the number of filled positions in the Cantonal ministries where the ratio of the currently employed personnel to the designated positions is 53%. This ratio is not any better in the above-listed professional institutions, which indicates that the available human resources are insufficient.

The analysis of the skilled personnel structure within the human resources, both the current one and particularly the designated one, indicates that there is an under-representation of certain types of required professionals. This is particularly related to the Cantonal ministries that will be facing increasingly complex requirements in the upcoming period. Judging by job titles, engineer jobs prevail in these ministries. The professionals for „water law“ are explicitly mentioned in three Cantons only, (Tuzla Canton, Middle Bosnia Canton and Herzegovina Neretva Canton), whereas in the latter two, there is only one position covering this area, designated in each of them. Other Cantons have not included these professionals in their plans related to the required skilled personnel at all, unless it has been incorporated in the job descriptions for other positions, such as „Assistant Minister for Water Management“ or „Head of Department “. Only in one Cantonal Ministry, (Posavina Canton), the position of „Database Operator“ has been planned. The Federal Ministry has planned one position titled „Consultant for Legal Affairs“ and one position titled „Associate for Water Management Information System Processing“. This kind of personnel structure cannot respond to the current requirements placed before the water sector in the Federation of BiH. It should be taken into account that the process of harmonization of the national legislation and institutional arrangements with the European Union water management framework, involves different personnel profiles than it is the case now. In other words, the deficiency of high-quality multidisciplinary skilled personnel is evident, and the key matter for a successful, sustainable water management is skilled and well trained personnel in all professional disciplines required in the processes of water resources planning, development and management. The unfavourable territorial distribution of skilled personnel is of particular importance, being reflected in the above-described structure and capacities of the personnel in the Cantonal ministries. It is a well known fact that the development of human resources at the local level makes a basis for successful and sustainable water management.

Organizationally, there is a vertical transfer of competences from the Federal Ministry to the operative and professional institutions, i.e. river basin district agencies, and eventually to the branch offices for the river basins and sub-basins (where such branch offices have been established). In other words, this is an extension of the competences held by the central, Federal Ministry. On the other hand, the Cantonal ministries have the local competence and by allocation of funds from water charges, they are also independent in terms of allocation of these funds in accordance with the Cantonal plans. The direct organizational linkage between the Cantons and the Federation of BiH is, under the Law on Water, planned through the district advisory councils, where the Cantonal representation is proportional to the area they cover in the relevant District.

3.2.7. Inspection Services

An important change in the organization of the inspection services, associated with water management at various levels, occurred after the adoption of the Law on Inspectorates in the Federation of Bosnia and Herzegovina⁵⁶, and it was reflected in the fact that consequently, the inspectorate has become an independent body with respect to the area it inspects. The Law stipulates that the inspection is carried out by the Federal and Cantonal inspectorates organized in the Federal Inspection Office and the Cantonal Inspection Offices. The work of the Federal Inspection Office is supervised by the Government of the Federation of BiH, while the Cantonal Governments supervise the work of the Cantonal inspection Offices. The Federal Inspectorate supervises the enforcement of the regulations within the competences prescribed in the Federal regulations, and correspondingly, the Cantonal inspectorate supervises the enforcement of the Federal regulations within the competences prescribed in the Cantonal regulations.

The Federal Inspection Office was established on 1 January 2007. Organizationally, this Office consists of the following inspectorates: market inspectorate, sanitary inspectorate, labour inspectorate, urban and environmental inspectorate, traffic inspectorate, agricultural inspectorate, forestry inspectorate, veterinary inspectorate, technical inspectorate and *water management inspectorate*. The tasks of the water management inspectorate include supervising the implementation of law enforcement related to water, water quality and use of water; regulation of watercourses; exploitation of mineral raw materials from river beds; construction of facilities in or near a watercourse; water-management governance; implementation of national and international obligations associated with water; and exercising the powers of public companies in implementation of the laws and regulations.

The establishment of the Cantonal Inspection Offices is in progress, in point of fact, the creation of legal conditions for their establishment is in progress⁵⁷. So far, such administrations have been established in (i) Zenica, for Zenica Dobož Canton; (ii) Tuzla, for Tuzla Canton; (iii) Goražde, for Bosnian Podrinje Canton; (iv) in Bihać, for Una Sana Canton and (v) in Široki Brijeg, for West Herzegovina Canton and (vi) for Sarajevo Canton. In all these Cantonal Offices, there is a water management inspectorate, which is organizationally, most often a part of the joint inspectorate, which also includes the agricultural inspectorate and the forestry inspectorate. The establishment of these administrations for the Posavina Canton is in progress.

⁵⁶ Official Gazette of the Federation of BiH No. 69/05

⁵⁷ Data dating back in July 2008

3.3. Economic Framework of Water Management

The Economic Framework of the Water Management Strategy for the Federation of BiH, in terms of the section describing the situation in this area, involves considering the following components:

- Main funding sources for different water management segments, both globally and in the Federation of Bosnia and Herzegovina;
- The current situation in terms of source revenues generated by the collection of special water charges, primarily by the river basin district agencies;
- The current situation in terms of the status and collection rate of the general water charge;
- The existing economic situation of the main water management segments: water supply, collection and treatment of waste water, protection of water and protection against water;
- The existing situation in terms of concession awarding;
- The existing situation in terms of privatization of water facilities.

3.3.1. Main Funding Sources for Water Management

Water infrastructure, anywhere in the world, is ultimately funded from one of the following two sources: (i) *Water consumers*, through direct expenditures or water invoices, paid to the water supply companies; (ii) *Fiscal revenues – budgets* at all government levels (based on the local or state-level taxes collected, and proceeds from state-owned property, goods and services) and (iii) *Grants and donations*, non-governmental organizations and charities.

The funding can be ensured through *loans* – commercial, local or international, inclusive of the international financial institutions, or through *equity investment*. Needless to say, the loans must be reimbursed and the equity investors will demand dividends and/or expect their share value to grow. If the three above-mentioned ultimate sources of funding cannot ensure the loan reimbursements and a reasonable rate of return on equity, the investment funds will not be available. The prior experiences indicate that the funds for financing the infrastructure and water facilities generally come from the following individual sources:

- Water consumers – such as households, farmers and enterprises;
- Public Water Supply Companies, financing their current maintenance and some new investments from the revenues collected from the consumers charges (gross operative cash flow) in the form of loans and occasional government subsidies;
- Private companies, local or foreign, ensure funds from the sources similar to the ones of public companies, plus additional funds in the form of share capital;
- Non-governmental organizations and local communities;
- Local banks and other financial institutions, offering short-term and medium-term loans at market interest rates;
- International banks and agencies for export financing;
- International donations from multilateral and bilateral sources, available under favourable loan rates or in the form of grants;
- Multilateral financial institutions;
- Environment and water funds;
- National central and local governments, providing subsidies, loan guarantees and debt instruments.

The estimated share of the individual financing sources in all segments, in the world in 2003 was as follows: national public sector - 69%; foreign aid - 17%; international private sector - 9% and national private sector - 5%.⁵⁸ A form of financing that is not used in the projects undertaken by the public sector is equity or share capital of private shareholders. High equity costs make it unattractive tool for financing projects associated with water⁵⁹.

In the Federation of BiH, this area is regulated by the relevant legislation, and accordingly, the Law on Water of the Federation of BiH (LOW)⁶⁰ lists the following sources of funding intended for implementing activities and tasks set out in this Law: (i) general water charges; (ii) special water charges; (iii) revenues generated by lease of public water property; (iv) budgets of the Federation, Cantonal budgets, city budgets and municipality budgets; (v) loans; (vi) funds provided based on a separate law; (vii) donations and other funds in accordance with the law.

3.3.2. Source Revenues of the Water Sector

3.3.2.1. Special Water Charges

The main source of finance for the Sava River Basin District Agency and the Adriatic Sea River Basin District Agency (i.e. the public companies responsible for the river basin districts until 1 January 2008) are special water charges. The special water charges are collected pursuant to the Law on Water and by-laws regulating the issues of rates, payers, terms and conditions of payment, etc. The special water charges represent public and own revenues of the River Basin District Agencies. Pursuant to Article 171 of the Law on Water of the Federation of BiH, on the joint proposal of the Federal Ministry of Agriculture, Water Management and Forestry and the Federal Ministry of Environment and Tourism, with the prior agreement by the Federal Finance Minister, the Government of the Federation of Bosnia and Herzegovina adopted the Resolution on the Rates for Special Water Charges. This Resolution, which entered into force on 1 July 2007 (superseding the Resolution on Charges, i.e. the rates of special water-management charges ("Official Gazette of the Federation of BiH", Nos. 46/98, 25/00, 7/02, 6/03), regulates the rates for the special water charges for: (i) use of surface water and groundwater; (ii) use of water in electric power generation; (iii) protection of water; (iv) extracting materials from watercourses and (v) flood control. All of the above-listed charges are collected in practice, save for the special water charge for flood control that has not been charged yet because the additional conditions and parameters for collecting this charge have not been provided yet.

The basis for collecting the water charges is contained in the "*polluter-pays*" and "*user-pays*" principles implying that a water polluter should pay the costs of treatment of the discharged polluted water, i.e. that the water user should pay a charge for using water as a common good. These principles are contained in the EU Water Framework Directive that regulates water management in the EU Member States. The arrangements stipulated in the Water Framework Directive are incorporated in the new Law on Water. The implementation of the Law on Water of the Federation of BiH requires, in addition to professional resources, large funds to achieve the desired water status objectives within a certain period of time. The Law on Water of FBiH,

⁵⁸ Andrew Taylor, "Shareholders could receive Pounds 18bn from utility mutuals – Kelda Water Group Sets Financial Trend", Financial Times, 16 June 2000, page 6., quotation taken from David Hall, "Financing water for the world – an alternative to guaranteed profits", March 2003, page 5

⁵⁹ In the UK, the private water companies' own advisors are now arguing that water prices in the UK, in terms of water use, could fall by 5% if the industry financed itself purely by debt, instead of the mixture of debt and equity used since privatisation.

⁶⁰ Official Gazette FBiH No. 70/06

essentially, kept the existing water sector financing system. According to the assessment of the Ministry of Agriculture, Water Management and Forestry of FBiH, and based on the information collected through questionnaires related to alignment of BiH legislation with the EU Directives, according to the current situation and the rate of fundraising intended for financing the water sector projects, BiH will reach the required standards in this area only in 2030 and not before.

The calculation and payment of water charges in the Federation of BiH is regulated in the Law on Water and the Rulebook on calculating, procedure and deadlines for calculating, paying and controlling the settlement of the liabilities arising from the general water charge and special water charges⁶¹.

The part of the funds allocated to the agencies (40%) should be used, under the Law on Water, for: (i) activities and tasks assigned to the agencies in accordance with the Law on Water, (ii) maintaining protection facilities owned by the Federation, (iii) other tasks and activities assigned to the water agency under this Law and (iv) financing the operation of the water agency. The part of collected revenues allocated to the Cantons (45%) is used for co-financing the construction and maintenance of the water facilities provided in Article 14, paragraph 1 of the Law (save for the facilities listed in item 3, lines 2, 4, 5 and 6 of this Article), as well as other activities related to the water management (development of technical documentation, basis for concession awarding, etc.). The revenues of the Environment Protection Fund of the Federation of BiH (15%) are, under this Law, used exclusively for implementation of the tasks assigned to the Federal ministry competent for environment and for co-financing the infrastructure for protection of water that is of relevance for the Federation.

The table below lists the main data on financial effects of the Resolution on the Rates for Special Water Charges, and the projected revenues from the special water charges by Canton, by river basin district and for the Federation of BiH, as well as their distribution among the beneficiaries of these funds.

No.	CANTON	TOTAL AMOUNT OF SWC	CANTONAL BUDGET 45%	WATER AGENCY 40%	ENVIRONMENT FUND 15%
1.	Sava River Basin District				
1.1.	UNA SANA	1.688.094,00	749.642,30	675.237,60	253.214,10
1.2.	POSAVINA	751.977,05	338.389,67	300.790,82	112.796,56
1.3.	TUZLA	8.094.430,71	3.642.493,82	3.237.772,28	1.214.164,61
1.4.	ZENICA DOBOJ	7.606.691,00	3.423.010,95	3.042.676,40	1.141.003,65
1.5.	BOSNIAN PODRINJE	168.280,97	75.726,43	67.312,39	25.242,15
1.6.	MIDDLE BOSNIA	1.717.933,13	773.069,91	687.173,25	257.689,97
1.7.	SARAJEVO	4.792.785,62	2.156.753,53	1.971.114,25	718.917,84
	Total 1:	24.820.192,48	11.169.086,61	9.928.076,99	3.723.028,87
2.	Adriatic River Basin District				
2.1.	WEST HERZEG.	1.031.374,72	464.118,62	412.549,89	154.706,21
2.2.	HERZEG. NERETVA	5.121.175,47	2.304.528,96	2.048.470,19	768.176,32
2.3.	LIVNO	731.615,47	329.226,96	292.646,19	109.742,32
	Total 2:	6.960.567,42	3.132.255,34	2.784.226,97	1.044.085,11
	Federation of BiH (1+2):	31.780.759,90	14.301.341,96	12.712.303,96	4.767.113,99

Table 3.3.1: Projected financial effects of the collected water charges in the Federation of BiH

⁶¹ Official Gazette of the Federation of BiH, No. 92/07

The previous summary table shows that the annual financial effect of the charges collection under the Resolution on the Rates for Special Water Charges totals KM 31,780,759.90, of course under condition of 100% collection rate. However, based on the previous experience in collecting special water charges, it can be stated with certainty that the collection rate will be significantly smaller. The current situation is such that the rate of water charges collection from public utilities performing water supply activities is very low. The Adriatic Sea River Basin District Agency has managed to collect only 17% of claims arising out of the special water charges from public utility companies. The situation is slightly better in the Sava River basin district where the collection rate for special water charges is around 43%⁶².

The problem associated with the collection of these funds rests with the fact that at the time of adoption of the new Law on Water, the compatibility of its provisions with the provisions of other laws applicable in the Federation of BiH has not been taken into account. Specifically, according to the Law on Water, the Tax Administration authority is explicitly referred to as an institution that is competent and obliged to control the collection of such funds from the public utility companies. However, this obligation does not exist in the Law on Tax Administration (defining the competences and operation of the Tax Offices), and therefore, from the legal point of view, these two laws are in conflict. Bearing in mind that the agencies alone do not have the capacity, by any means, to force the public utility companies to pay the special water charges, their payment is at this point merely a matter of good will of the public utility companies. In 2006, the *Budget of the Federation of BiH* received KM 2,590,162 from the collection of special water charges, while at the same time KM 1,450,000 was allocated to the water management-related activities⁶³.

3.3.2.2. General Water Charge

Person obliged to calculate and pay the general water charge is any physical and legal person registered for performing business activities pursuant to a decision issued by a competent authority. The general water charge is paid by the employer, i.e. salary payer, to the amount of 0.5% of net salary of all employees, simultaneously with paying the salaries to the employees. Starting from the fact that in the Federation of BiH, there are approximately 300,000 employees (excluding those employed in state administration who are not subject to general water charge payment) and that the average salary in the Federation of BiH amount to KM 700, the total anticipated amount of the general water charge comes to KM 12,600,000 over a period of one year.

3.3.2.3. Other Finances

On 8 March 2006, the Federal Government adopted the 2006 – 2008 Public Investment Programme. The Government of the Federation of BiH, the Ministry of Finance of FBiH and the competent Federal and Cantonal ministries are committed to use the 2006 – 2008 Public Investment Programme as a basis for mobilizing foreign aid (donations and loans) in the negotiations with foreign creditors and donors. The total funds specified in the 2006 – 2008 Public Investment

⁶² According to the information received from the Adriatic Sea River Basin Agency, the debts arising from the outstanding special water charges significantly burden the operations of the Agency and represent ballast in the financial statements being carried forward as outstanding receivables from one year to another. According to the information received by the taxpayers themselves i.e. the public utility companies, in 2007, the total outstanding debt exceeds KM 500,000. The total outstanding liabilities of the public utility companies arising from the SWC, in the period 2003-2006 amount to approximately KM 3,500,000.

⁶³ In June 2007, the Government of the Federation of BiH passed decision to adopt the Fund Allocation Programme in accordance with the 2007 Budget of the Federation of Bosnia and Herzegovina under the budget position "Capital Grant for Water Management Sector". The 2007 FBiH Budget funds allocated from the Capital Grant for Water Management Sector to the amount of KM 2,150,000 were distributed to different water management projects, as follows: (i) Water protection – KM 985,000; (ii) Protection against adverse effects of water – KM 405,000 KM and (iii) Rehabilitation of the facilities intended for protection against floods that are owned by the Federation of BiH – KM 760,000.

Programme amount to KM 1,334,700, out of which KM 365.2 Mio (27 %) comes from national sources and KM 969.5 Mio (73 %) from the foreign ones. In the Public Investment Programme, the share of the water sector is 19 %. The largest proportion of the nominated projects covered by the Public Investment Programme comes from the area of water supply and waste water management (36 %).

According to the information from the Ministry of Agriculture, Water Management and Forestry of the FBiH (the Ministry), around KM 16.0 Mio was allocated from the Budget of the Federation of BiH to the water sector in 2008, out of which KM 12.5 Mio was allocated to the Cantons and Municipalities to support them in the construction and reconstruction of the water infrastructure facilities. The environment and water sector was included in Category I under the IPA funds⁶⁴ in 2008 for BiH, which is very important in terms of the prospects for obtaining the funds required for financing the water-related projects.

The Government of the Federation of BiH has accepted to receive a loan amounting to 60 million Euro under the Agreement between BiH, the Federation of BiH and the European Investment Bank (EIB) for the purpose of financing the „Water Supply and Sewerage Project in the Federation of BiH“.

According to the information from the World Bank office in Zagreb, on 30 May 2008, the World Bank approved two grants from the Global Environment Facility totalling 8 million US dollars for the Neretva and Trebišnjica Management Project: 6 million US dollars for Bosnia and Herzegovina and 2 million US dollars for Croatia.

3.3.3. Current Economic Situation in the Main Sectors of Water Management

Due to exceptionally difficult situation, in terms of the lack of funds for investing in all segments of water management, the Ministry in October 2007 sent a letter, i.e. a document to the Government of the Federation of BiH titled „Programme for Spending Funds Gained from the Privatization for Financing Water Infrastructure“, presenting the specific proposals and the breakdown of funds required for financing the water infrastructure.⁶⁵

The municipal water services fall under the competence of local authorities (or at the regional/Cantonal level) that are obliged to, either independently or in cooperation with others, ensure activities in their respective areas. For the purpose of performing these activities, the local authorities may establish a utility company, as a public institution, or assign these activities to other legal or physical entities based on a concession agreement or an agreement on assigning the water-supply and waste water drainage activities. The service provider is responsible for management and operation of the water infrastructure. The revenues from performance of these activities are gained through the service charges paid by the users. The components of the water price include water supply service; drainage and treatment of urban waste water service; financing and maintaining the infrastructure; source protection; water protection; water use; VAT on public utility services; and most probably, in the future, water abstraction concession. The water supply companies gain their revenues:

⁶⁴ Instrument for Pre-Accession Assistance – IPA, established for the purpose of EU perspective development for the Western Balkans countries.

⁶⁵ For the water supply sector, the amount of 950 million KM is required to bring the water supply system back to the pre-war level. This assessment was made immediately after the war (1996). However, the Ministry's estimation is that this 1996 assessment and cost estimate are still relevant.

- By supplying the basic services of water supply, drainage and treatment of urban waste water;
- By supplying other services in this area (for example, waste collection and removal);
- From subsidies allocated from the Cantonal Budget.

The water supply companies are mainly organized as independent municipal entities, and therefore, the maintenance costs, i.e. operative costs are in a large number of cases irrational, and in some cases they are even unnecessarily high. The public utility organizations responsible for water supply cannot fully accomplish the tasks assigned to them. There are several reasons for this, and one of the most important is a low debt collection rate for the water supplied, with unit prices that do not correspond to realistic economic parameters. In the existing situation, it is evident that without permanent, secure and sufficient funds, it is impossible to carry out all legally prescribed functions of simple and extended reproduction. The lack of funds for reconstruction and development of infrastructure facilities is particularly difficult, and these funds should be provided from the sources listed in the Law on Water, as follows:

Federal and Cantonal budgets – In the cases when the funds provided from source revenues are not sufficient for financing new facilities, which has always been the case so far, then the Federation or the Canton must provide all or majority of funds for such investment financing from their respective Budgets.

Special Purpose Loans – These funds are available in the Budgets of the Federation of the Cantons, or the Federation of BiH should ensure favourable bank loans.

Public Loans – These funds are to be provided by the State in cases when it is necessary to ensure a specific investment financing in a short period of time. (In this matter, the Law stipulates the possibility that the Federation floats a public loan for collecting the required funds).

Funds provided under a special law – If necessary, the Federation may decide to adopt a special law for the purpose of ensuring the necessary funds for a particular investment in one of the segments within the water sector scope of work.

Donations and other funds – Under the other funds in this category of funding sources, the Law, probably, stipulates an insufficiently defined range of funding sources, both national and foreign, being granted under favourable repayment conditions including a very long period of reimbursement and low interest rates, given the fact that such other funds were placed in the same category as donations. Obviously, there no funding sources that are more favourable than donations, however, the current situation points to the facts that the time of plentiful donations is a matter of economic past for Bosnia and Herzegovina. It is likely that bonds, as one of the main group of long-term securities (in the developed secondary markets) used for securing (marketing) of long-term financing could fall under this category.

In the current situation, the chain of competences and responsibilities in the water supply sector consists of the following major entities: the Ministry of Agriculture, Water management and Forestry of FBiH; the Cantonal Governments; and the Municipalities that transfer this responsibility to the water supply companies. The latest Law on Water, particularly emphasizes the role of the Cantons and municipalities in terms of municipal water infrastructure (e.g. the Law on Water stipulates that the revenues generated by the lease of public water property on Category II surface waters is to be fully allocated to the Cantonal budget). The municipalities are responsible for identifying the needs for the water sector development on their territory, setting out models for satisfying these needs in the most efficient way, and eventually allocate funds required for

implementation of the accepted projects. The municipalities notify the Cantons of their intentions and decisions and the Cantons should use the available funds for co-financing the water supply projects, together with the funds available in the Budget of the Federation of BiH that should also be used to assist the co-financing. Based on this chain of responsibilities in the water supply sector, these are the possible funding sources:

- Government Budgets at the Federal, Cantonal and municipal level;
- Revenues from providing services, collected by municipal public utility companies from different categories of consumers;
- Specific taxes, i.e. special and general water charges.

In the current situation, the companies engaged in water supply in the Federation of BiH are expected to accomplish various, sometimes mutually conflicting objectives, taking into consideration the specific features of the services they provide and the importance of water as a scarce resource in economic, environmental, social and political sense. The companies are expected to operate in the market and in accordance with market principles, sell their services and gain their revenues that would be used for financing the maintenance of the existing infrastructure, but also for their development. However, the price of water has been used as an instrument of social policy and it is deliberately kept at the level that is far from the economic price that could provide for covering all economically and technologically justifiable costs in the operations of the companies engaged in water supply, collection, drainage and treatment of waste water.

The current arrangement involves application of price calculation and debt collection system that is very simple from the operative point of view. There are only two tariff groups of customers: households and enterprises, meaning that there are different prices for each of these two groups. The method for price calculation is a linear one, which means that there is no distinguishing by quantitative consumption blocks. The same price is paid for any quantity of water used. The existing pricing system is not encouraging more rational consumption of water, creating a very difficult situation for the companies and resulting in operating losses, which are now typically covered from the Cantonal budgets.⁶⁶ The unsatisfactory debt collection rate for the water supplied represents an additional problem.⁶⁷

According to the practice in the EU countries, in terms of pricing, it is insisted on determining *an economic price of water* in order to: (i) discourage water consumption, (ii) enable sustainable water supply quality, and (iii) ensure sufficient funds for development of water supply companies. In spite of the fact that BiH is facing major problems in terms of the social status of the majority of population, setting prices below average total costs, in fact, only enlarges the problem of “normal” functioning of the water management companies. However, it should be emphasized that the public utility companies engaged in water supply should accept the fact that the economic price of water implies covering only those operating costs that are economically, organizationally and technologically justifiable and not simply any costs. It is evident that there is room for improvement of internal economy in terms of making improvements in business effectiveness and for example, more efficient energy consumption. In this sense, it is evident that water supply companies are not sufficiently motivated to use the resource being entrusted to them in a more rational manner. In connection with this subject, the example of the water charge that these companies are obliged to

⁶⁶ In the current situation, if it was not for the subsidies provided by the Cantonal Governments, as well as their contribution through budgetary transfers, which makes up to 30% of the revenues generated by the water supply companies, these companies would not even be able to cover their basic operating costs.

⁶⁷ JKP ViK *Sarajevo* claims 55 million KM from the consumers; JKP „Vodovod“ *Bihac* claims around 6 million KM from all the consumers; JKP „Vodovod i kanalizacija“ *Tuzla* claims around 24 million KM, and in JKP „Vodovod“ *Zenica*, the outstanding receivables for the water supplied amount to approximately 2 million KM.

pay on the basis of the right to use the water resource is often used. According to the previous law, the companies were paying the water charge for using the water resource at the rate of 0.05 KM per m³ of the *supplied* water. According to the most recent Law, this liability has been reduced to 0.01 KM per m³ of *abstracted* water.

This situation should be changed (i.e. the water abstraction charge should be increased) because it is not motivating with respect to more rational consumption of natural water resources. Taking into consideration the significance of these companies, their presently exercised monopolistic right to use the water resources for the purpose for which they have been established, as well as the volumes of water they are abstracting, it should be pointed out that this arrangement is not in compliance with the main requirement stipulated in the Law on Water, which emphasizes that water resources management must be organized in accordance with the principles of sustainable water management and preservation of water resources.⁶⁸ The table below gives an overview of water abstraction charges in some other European countries.

Country	Water abstraction charge	Rates
Bulgaria	Not applicable	Not applicable
Czech Republic	-surface water -groundwater	- rates are set by river basin management company -0.05 EUR/m ³
Estonia	All sources	-between 0.0019 EUR/m ³ and 0.96 EUR/m ³ depending on water source and use of water
Hungary	All sources	between 0.006 EUR/m ³ and 0.04 EUR/m ³ depending on use of water
Latvia	-surface water -groundwater	-0.003 EUR/m ³ -0.016 EUR/m ³ rate for mineral water is between 0.08 EUR/m ³ and 0.161 EUR/m ³
Lithuania	-surface water -groundwater	-rate depends on the use of water -0.009 EUR/m ³ (households); 0.02 EUR/m ³ (industry) and 1.22 EUR/m ³ (mineral water)
Poland	-surface water -groundwater	-0.027 EUR/m ³ -0.08 EUR/m ³
Romania	-surface water -groundwater	-0.005 EUR/m ³ – 0.0006 EUR/m ³ -0.006 EUR/m ³
Slovakia	-surface water -groundwater	-0.5 EUR/m ³ -0.02 EUR/m ³ for public water supply and 0.5 EUR/m ³ for other uses
Slovenia	Not applicable	Not applicable

Table 3.3.2.: Water charges in some European countries

(Source: REC 2000; Reference: Agnieszka Laskowska and Frank Scrimgeour: "Environmental Taxation: The European Experience", <http://wms-soros.mngt.waikato.ac.nz/>)

In the area of protection against detrimental effects of water, the estimated current value of the main facilities associated with the protection against water in the Federation of BiH on the Category I watercourses in 2008 was KM 148,900,936 in total, out of which figure, 99.515.970 KM or 66.83% in the Sava River basin district and, KM 49,384,966 or 33.17 %, in the Adriatic River Basin District. The current revenues of the water agencies do not even cover an approximate amount of the funds required for covering the operating and investment costs of the existing facilities. In this sense, a proper illustration would be the data that the Public Company for the Sava River Basin District, together with other participants in the period between 1997 and 2007 invested (mostly in the facilities along the Sava River) only around 17 million KM or 1.7 million KM at average annually.⁶⁹

⁶⁸ By comparison, the water use charge calculated on the basis of the water supplied and charged in Croatia amounts to 0.80 kuna/m³, which is 0.20 KM (according to the middle exchange rate of 4.1 kuna per 1 KM, on 6 June 2008). The water protection charge is 0.90 kuna /m³, which is 0.22 KM. (Source: <http://www.voda.hr/Default.aspx?sec=182>).

⁶⁹ At the time of the report drafting (15 May 2008), the Government of the Federation of BiH has not passed the decision to allocate part of the funds collected from the privatization proceeds for funding the water infrastructure in all three above-mentioned segments.

3.3.4. Current Situation in the Area of Concessions in the Water Sector

In accordance with the previous 1998 Law on Water and the previous 2000 Concession Award Decree stipulating methodology for awarding concessions, as well as in accordance with the Rules for Determining the Rates for Concession Charges for all types of concession agreements, the Federal Ministry of Agriculture, Water Management and Forestry (“Ministry”) awarded a total of 10 concessions, as follows: 4 concessions for water bottling; 3 concessions to public water supply companies (Zenica, Tuzla and Travnik) and 3 concessions for using medical spas (Sanski Most, Ilidža and Olovo).

The Government of the Federation of Bosnia and Herzegovina has been considering the fact that currently three public water supply companies that have been awarded water concessions and that must pay the prescribed concession charges arising out of their concession rights, are practically placed in a less favourable economic position in comparison to other public utility companies that have not signed the concession agreement and that are not paying the additional concession charges. In the current legal framework, the Cantons have no competences in awarding water concessions. The Cantons award concessions for small hydro power plants construction and water bottling. The problem is that no information on these matters are delivered to the Ministry of Agriculture, Water Management and Forestry of FBiH (“Ministry”), because the regulatory provisions have been interpreted in such a manner that the Ministry has merely an advisory role in spite of the fact that the Cantonal laws are required to be harmonized with the Federal regulations covering this area. The state-level Concession Commission should eliminate this inadequacy and have access to all information regarding the awarded concessions. Namely, since 2002, when the Federal Law on Concessions⁷⁰ was adopted, the Ministry has not had any competences in terms of concession awarding. The Ministry sent a letter to the Government requesting this model of awarding concessions to be reconsidered. The standpoint of the Ministry, which was stated in the Conclusion on Harmonizing the Concession Charges and delivered to the Government, is that the water concessions should be awarded to the municipalities instead of utility companies. Namely, the audit that was conducted in 2007 demonstrated that there were certain discrepancies in the calculated concession charges because these charges were calculated in accordance with the old Rules on Concession Fees for the 10 awarded concessions. The harmonization of the rates for concession charges with the applicable provisions is in progress.

3.3.5. Current Situation in the Area of Privatization in the Water Sector

The privatization in the water management sector has not been instigated yet, except for some individual cases in some of the Cantons. For instance, in Tuzla Canton, the privatization of water supply facilities has been carried out with support of USAID (United States Agency for International Development). The process of reviewing this decision is currently underway; however, the problem that recently emerged rests with the fact that the certificates were used in this privatization, and now, in case of a decision recall, cash should be returned to the investment funds that took part in the privatization process. In the current situation, there is also the problem of deficient or considerably reduced public investments in the private infrastructure.

⁷⁰ Official Gazette FBiH No. 40/02

The Ministry is of the opinion that the water infrastructure and facilities should not be privatized under any circumstances, and that the utility company is the only one that should be privatized (In this case the titleholder would designate the entity that would be using the facilities in its business operation in the most efficient way)⁷¹. The World Bank estimates that the private sector supplies about 5% of those currently receiving a clean water connection – a financial analyst puts the figure at 7%⁷²; the other 95%, or 93%, are served by the public sector.⁷² Accordingly, an interesting conclusion could be drawn that the private sector cannot be expected to be the main engine of growth in the water management sector.

3.4. Water use – the status indicators

3.4.1. Introduction

Water use, pursuant to the Water Law of the Federation BiH comprises the following aspects:

- abstraction, pumping and use of surface waters and groundwaters for different purposes (drinking water supply, sanitary and technological needs, irrigation, etc.);
- the use of water power for power generation and other energy purposes;
- water use for fish farming;
- water use for navigation;
- water use for sport, bathing, recreation and other similar purposes.

Water use for drinking water supply of the population, sanitary needs and fire-fighting needs is given priority in relation to other purposes.⁷³

3.4.2. Population water supplying

The most important task in the field of water use is to provide drinking water of the highest quality for the population and industries. Population water supplying in Bosnia and Herzegovina dates as early as the Roman Empire period. Water supply systems date, to a rather considerable extent, from the period of Turkish Empire rule, when the first public water supply system was built in Sarajevo in the first half of the 15th century, much earlier than in other European towns. During the Austrian-Hungarian Monarchy rule, a number of water supply systems modern for that time were built together with water treatment plants, some of which are in function even today.

A common problem encountered in analyses of the existing status in any field is the way and possibilities of data collecting and then checking and evaluating their validity. This problem has been pointed out for years, and some improvement has been made in relation to it: education of personnel in public utility companies and municipalities, working out of data bases, elaboration of studies, establishing of information systems run by the water agencies for the Sava and the Adriatic Sea river basin districts. Dealing with the present water supply status, the following approach has

⁷¹ Some of the countries allowed the privatization of water supply systems in order to improve the services and the quality of the water supplied. However, the result of this was mainly reflected in increase of water prices and none or very small improvement in service quality. So, for instance, in Bucharest, Sofia and Budapest, where the privatization of water supply system took place, the price of water is around 3 Euro/m³.

⁷² Andrew Taylor, "Shareholders could receive Pounds 18 bn from utility mutuals – Kelda Water Group Sets Financial Trend", Financial Times, 16 June 2000, p. 6., quotation taken from David Hall, "Financing water for the world – an alternative to guaranteed profits", March 2003, p. 5

⁷³ Acc. to Article 44 of the Water Law of the Federation BiH.

been applied: analysis of coverage by water supply systems, sources of water supply, total abstracted and delivered water quantities, water quality, specific consumption status and quality of water supply systems, etc.

Starting point for analysis of the water supply status is, of course, the number of inhabitants per river basin districts. Report by Federalni zavod za statistiku (the Federal institute for statistics) – “Estimate of number of inhabitants per cantons and municipalities” from 2007 was used, while the number of inhabitants per certain river basin districts both at the level of river basins and sub-basins has been estimated by means of the data provided in GIS software.

3.4.2.1. Population covered by water supply systems

On the basis of available data, about 60% of the population in the Federation BiH is covered by public water supply systems (in urban regions the coverage is 94% of the total population; in rural regions it is considerably lower and amounts to 20%). The following table shows the coverage by public water supply systems per river basin districts:

No.	River basin district	Number of inhabitants connected to public water supply systems (inhab.)	Total number of inhabitants (inhab.)	Percentage of inhabitants connected to public water supply systems (%)
1	The Save RBD	1,179,900	1,958,166	60
2	The Adriatic Sea RBD	214,666	369,346	58
Total:		1,394,566	2,327,512	60

Table 3.4.1: Population covered by public water supply systems

Other inhabitants meet their water requirements by individual, group and local water supply systems, the competence and management of which are not in charge of public utility companies.

3.4.2.2. Abstracted and delivered water quantities

Total abstracted water quantities for water supply needs in the Federation BiH are about 261,542,143 m³/year which for 1.39 million inhabitants covered by public water supply systems gives the gross specific consumption of 512 l/inhab./day.⁷⁴

⁷⁴ Specific consumption structure is as follows:

- Consumption in households, i.e consumption in houses or in flats. Included within this item of specific consumption is also consumption in public institutions such as schools, military barracks, health institutions, but also losses in water supply systems which for our circumstances are very pronounced in the total structure of water consumption;
- Consumption in industries which are connected to the municipal water supply network and which in their technological processes use drinking water quality. Meeting water requirements for watering of gardens and farmsteads and individual cattle breeding, which primarily relates to rural settlements is also comprised in this item of specific consumption.

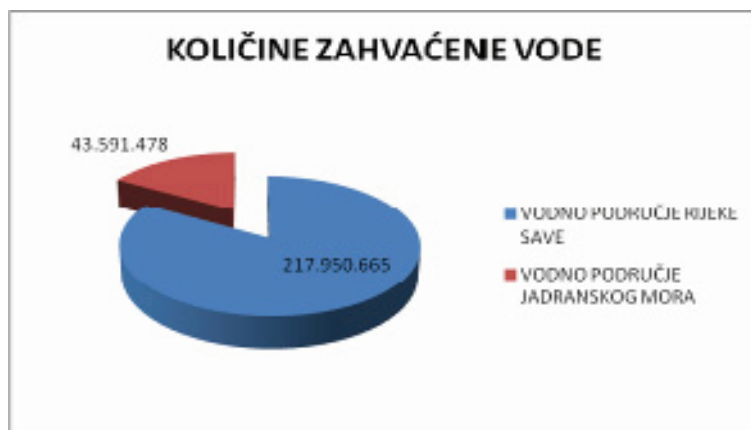


Fig. 3.4.1 Total abstracted water quantities according to river basin districts

A number of public water supply systems in towns, and especially in villages, are still unable to meet basic requirements of water users in certain periods of the year, both in view of quantity and often in quality. As a result thereof, regular reductions are frequent – particularly in the river basin of the Krka and Cetina rivers (The Adriatic Sea RBD), and in northern parts of the rivers Bosna and the Drina sub-basins (The Sava RBD). One of the reasons for such reductions in water delivery is losses in the water supply systems.⁷⁵

Under such circumstances it is exceptionally difficult to provide uniform distribution of available water quantities to all users and basic hygienic conditions. It should be mentioned here that enormous losses partly result from the fact that utility companies that manage water supply systems are not able to keep records of delivered water quantities due to poor equipment they dispose of.

Obtained values of specific consumption by the population are extremely low for some municipal centres. The reason for that can be found in poor record keeping of water quantities that enter the system, i.e. at household water meters, and in inconsistent presentation of net and gross consumption. Very often these water supply systems are in municipal centres with reductions in water delivery lasting at least 8 hours a day, either due to inadequate capacity of the source area or inadequate structures for transport, storage and distribution of water, with a high percentage of losses, or, unfortunately also due to combination of all three reasons, that being the most frequent case.

In general, for regions with regular water deliveries, a conclusion can be made that the values of current specific water consumption for households amount to 120 l/inhab./day, which is also the average specific consumption by population for the area of the Federation BiH. Average specific consumption by industries connected to the municipal water supply network (according to available data) is about 64 l/inhab./day.

It can be seen from the above that the present specific consumption by households in municipal centres of the considered area of the Federation BiH which have regular water supply, is mainly within the usual values for European countries with similar climate, development degree, technological development and the like. In terms of water supply, the biggest towns of the

⁷⁵According to data of the Association of Water supply companies in Bosnia and Herzegovina leakages in some systems are as high as 80% of the total abstracted water quantities).

Federation BiH – Sarajevo, Tuzla, Mostar and Zenica – have their specific features and their consumption significantly affect the total consumption, as shown by the following graph:



Fig. 3.4.2: Distribution of abstracted water quantities per towns in FBiH

3.4.2.3. Review of water supply resources

For meeting water supply requirements by population, surface and groundwater sources are used in proportion shown in the following table:

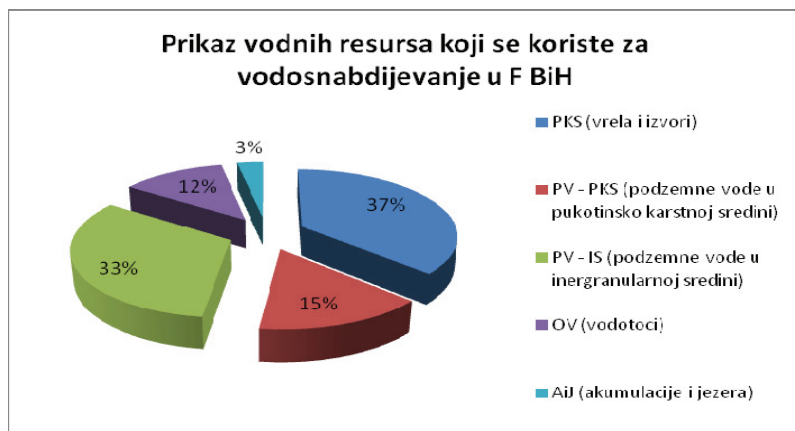


Fig.3.4.3: Water resources used for water supply in the Federation BiH

3.4.2.4. Delineation of water supply status according to river basin districts

3.4.2.4.1. The Sava RBD

According to estimates, the total of about 1,958,166 inhabitants⁷⁶ live in the considered area. i.e. in the part of the Sava river basin district belonging to the Federation BiH. The distribution per individual sub-basin districts is as follows:

⁷⁶ Data source:: GIS data base of the Agencies of the Sava and the Adriatic Sea RBD

No.	The Save river basin district	Number of inhabitants, estimated in 2007.
1	The Bosna river sub-basin	1,341,727
2	The Vrbas river sub-basin	120,868
3	The Una river sub-basin with the Glina and the Korana rivers	302,487
4	The Drina river sub-basin	57,526
5	Immediate Sava river basin	135,557
TOTAL		1,958,166

Table 3.4.2: Estimated number of inhabitants for the Sava RBD, Federation BiH

About 52% of the total population live in municipal centres, and the remaining 48% in rural areas.

For the whole considered Sava RBD about 60% of the population is connected to public water supply system. The percentage covering urban population is 97%. As to inhabitants of other settlements connected to water supply systems of municipal centres, or local systems which are maintained by a responsible municipal utility company, the coverage is about 16 %⁷⁷. In fact, out of total population the number of those supplied with water by such public water supply systems is about 1,179,900. According to available data, total quantities of water abstracted from sources for water supply purposes amount to 217,950,665 m³/year.

The table in the text below shows data on abstracted and delivered water quantities plus a graphic presentation:

The Sava RBD	Water quantities abstracted at the source/sources (m ³ /year)	Number of inhabitants served by water supply systems	Gross specific consumption (l/inhab./day)
The Bosna river sub-basin	172,674,957	865,004	547
The Vrbas river sub-basin	7,693,848	48,565	434
The sub-basin of the rivers Una, Glina and Korana	26,959,668	194,800	379.2
The Drina river sub-basin	7,022,432	29,300	656.6
Immediate Sava river basin	3,599,760	42,231	234
Total:	217,950,665	1,179,900	506

Table 3.4.3: Gross specific consumption of water per analyzed areas

The average, *gross specific water consumption*, expressed as a relationship between total abstracted water and total number of inhabitants covered by public water supply systems is 506 l/inhab./day. This gross specific water consumption covers: specific consumption of households, industries and institutions, and also unaccounted for water quantities, i.e. losses.

⁷⁷ Data taken from „Long-term programme for drinking water supply of population and industries of FBiH“, 2003.

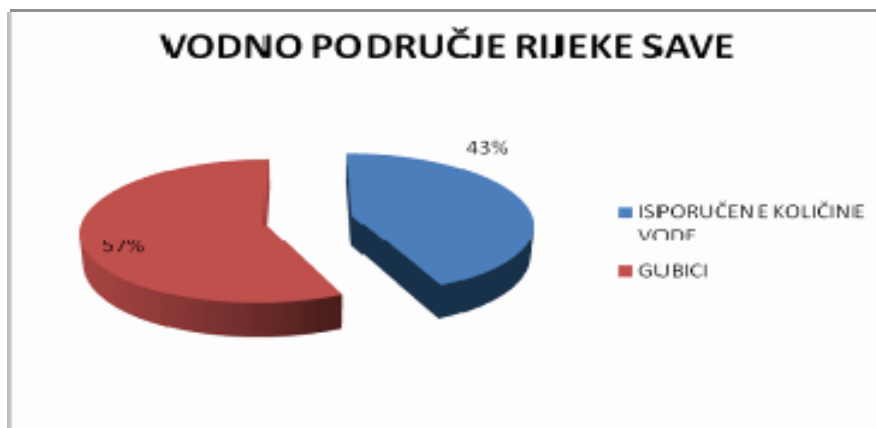


Fig. 3.4.2: Delivered water quantities and losses

The quality of water supply as described in the text above can be evaluated as inadequate both in terms of the present time and water users' requirements. Frequent reductions, great water losses, inadequate capacity of source areas and dilapidated distribution network are either entirely or partly characteristic for almost all of these water supply systems.

Structure of source areas used for water supply is as follows:

- Fracture-karst media which occur on the surface in the form of springs and sources 36%;
- Groundwaters from fracture-karst media 9 %;
- Groundwaters from intergranular media 39 %;
- Open watercourses 13 %;
- Artificial reservoirs and natural lakes 3 %,

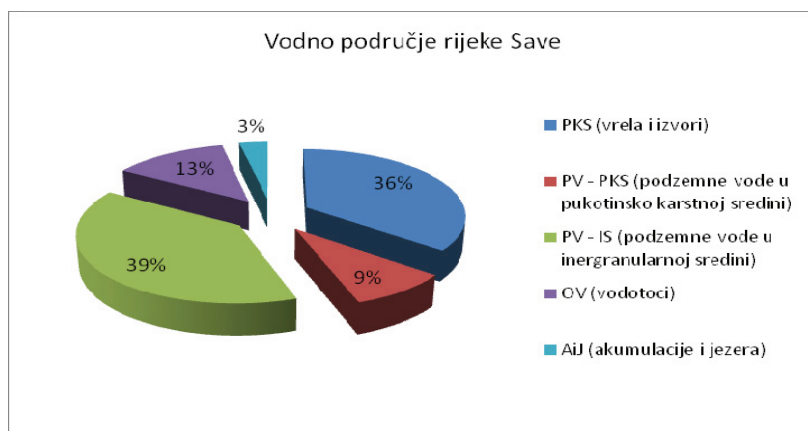


Fig.3.4.3: Source areas used for water supply - The Sava RBD

Water supply from reservoirs is surely a good solution for regions with inadequate water quantities coming from other sources. Currently such water abstraction structures are applied in the Vrbas river sub-basin – Jajce, and in the Bosna river sub-basin – regions of Tuzla and Gradačac. Open facilities for water abstraction from watercourses are mainly applied in regions poor with water (e.g. Goražde) and also as an intervening solution in regions where much time and money is required for

providing additional water quantities from other resources of better quality. The most presented are water abstraction structures of springs, sources and groundwaters, which at the same time are the water sources of the best quality.

Water quality at water abstraction locations, especially in open water abstraction facilities (watercourses and reservoirs) is in most cases inadequate, and requires previous treatment. The quality of groundwater sources is mostly satisfactory. Deviations occur usually in heavy rain periods when turbidity is observed to a certain degree. In the Sava RBD, the number of constructed plants for drinking water treatment is 25 in total.

There follows now a review of water supply status according to sub-basins.

The Una river sub-basin with the Glina and the Korana rivers:

On the basis of available data, about 198,800 inhabitants are covered nowadays by public water supply systems, which is 65% of their total numbers according to estimates from 2007. The Una river sub-basin with rivers Glina and Korana covers the whole municipalities of Bihać, Cazin, Velika Kladuša, Bužim, Bosanska Krupa, Bosanski Petrovac, Sanski Most, Ključ, Drvar, and partly some municipalities which by their larger portion belong to other river basins: Glamoč and Bosansko Grahovo.

The public water supply systems are managed by 9 utility companies. Specific consumption by population in this river sub-basin amounts to about 115 l/inhab./day and by industries about 61 l/inhab./day. The total abstracted water quantities are 26,959,668 m³/year - 8,007,488 m³/year for population and 3,956,157 m³/year for industries. Losses are estimated to 51% on average. Activities currently underway in this region are mostly oriented to reconstruction of water supply systems, with the objective to reduce losses. Noticed are certain fluctuations within the canton and some municipalities in relation to coverage by public water supply systems and their quality. Also, in relation to pre-war data, it can be noticed that total delivered water quantities at present are almost close to the pre-war ones. It is also noticed that water quantities delivered to inhabitants are considerably higher than the ones delivered to industries and other users. This is in line with intensive post-war activities on reconstruction and expansion of water supply systems, in which water supply of population has been set forth as a priority, as a basic prerequisite for living standard improvement.

Geographic information system has been established for managing water supply systems for almost all municipalities in which data on all structures can be obtained. Also, activities have been intensified in relation to elaboration of projects on Protection of source areas. Elaborates were worked out and decisions for most of the source areas made by municipal councils in charge of establishing of sanitary protection areas. However, the problem of implementation is still pending.

The existing water abstraction facilities in this region are groundwater structures, as follows:

- Fracture-karst media (sources and springs) – 72% (regions of Bihać, Bosanski Petrovac, Ključ, Drvar, and Sanski Most...),
- Intergranular media (wells) – 10% (regions of Bosanska Krupa, Velika Kladuša),
- Groundwaters (Fracture-karst medium) – 18% (region of Cazin, Bužim).

The capacity of water abstraction facilities ranges from 5 l/s to 1000 l/s (Klokot-Bihać). In most cases water is of satisfactory quality, so that only disinfection of water is carried out. The only

water treatment plant is built in Sanski Most in which coagulation, flocculation, sedimentation, filtration and disinfection of water are performed.

In the considered region, there are currently 343 local water supply systems in operation that provide water for about 92,000 inhabitants, which is about 30% of the total population in the canton. Out of this number, water disinfection is carried out in only 18 water supply systems which are mainly the systems under control of utility companies.

The Vrbas river sub-basin:

The Vrbas river sub-basin in the Federation BiH covers entire municipalities of Jajce, Dobretić, Bugojno, Donji and Gornji Vakuf, and parts of municipalities that belong to other river basin districts: Glamoč, Kupres, Novi Travnik and Travnik.

According to the 1991 census, the total number of inhabitants in the river Vrbas sub-basin in the Federation BiH was 103,500 and according to estimates from 2007 that number is now 120,000. Most inhabitants live in Bugojno and Jajce. About 48,000 inhabitants or 40% are covered by public water supply systems. Specific consumption by population for this sub-basin is about 138 l/inhab./day. Total abstracted water quantities are 7,693,848 m³/year. Out of that quantity about 2,317,164 m³/year are delivered to the population and 1,700,024 m³/year for industries and public consumption. Network leakages are estimated to be about 39% on average, but in certain areas (parts of municipalities with worn-out network) they can be as high as 70%. Water networks are, generally, in poor conditions especially due to very old pipes. Activities currently underway in this area are oriented mostly to reconstruction of water supply networks, aiming at reduction of losses. Noticed are certain fluctuations within the canton and some municipalities in relation to coverage by public water supply systems and their quality. In the region of five municipalities in the Vrbas river sub-basin in the Federation BiH there are many local water supply systems which are under local communities' control (Bugojno 23 local water supply systems, Donji Vakuf 50, Gornji Vakuf about 36, Jajce and Dobretić about 40). According to estimate as many as 40,000 inhabitants are supplied with water from local water supply systems. In the forthcoming period activities will be undertaken to make an inventory of these water supply systems in order to plan their registration and thus establish control over them.

There are no detailed maps of and data on the existing water networks. Actually, they are in the course of being made. Water quality is satisfactory. Regular control is carried out in all systems that are under surveillance and management of utility companies. Water disinfection is done in all systems.

The existing water abstraction facilities in this region are groundwater structures, as follows:

- Fracture-karst media (sources and springs) – 78%, 9 sources with abstraction capacity of 2-300 l/s (region of Bugojno, Gornji and Donji Vakuf, and a smaller part of Jajce)
- Reservoirs of Plivsko jezero and Jezero (surface water abstraction) – 22% (Jajce region): Capacities of these abstraction structures are from 10 l/s to 100 l/s.

In cases of water abstraction from reservoirs where water quality is not satisfactory, there are water treatment plants made: Plivsko jezero and Jezero (water supply of the town of Jajce).

The Bosna river sub-basin:

The Bosna river sub-basin is the most densely populated and most developed area in the Federation BiH and, consequently, with most pronounced requirements in view of water supply. About 865,000 inhabitants in this sub-basin district are supplied with water from public water supply systems. The total of abstracted water quantities amounts to 172,674,957 m³/year. About 64% of the population are connected to public water supply systems. This percentage is significantly higher in municipal centres than in other settlements. It should be also mentioned here that gross specific consumption and specific consumption by population and industries vary from one area to another. High gross specific consumptions are found in the largest municipal centres: Sarajevo, Tuzla and Zenica, but also in Busovača, Ilijaš, Zavidovići, Vareš, Olovo and Banovići. The reason thereof is mostly in high losses in the systems. This can be said with enough certainty for the largest municipal centres because they have regular measurements and adequately reliable data on quantities of abstracted and delivered water quantities.

However, in smaller towns and settlements, where data are less reliable, the reason for drastically high or low specific consumption can be found in inadequate quantities of abstracted water, in low coverage by water supply systems and also in losses in the water supply systems. So, for example, the gross specific consumption for the Bosna river basin in the Federation BiH is 547 l/inhab./day, while the average specific consumption by population is 100 l/inhab./day. Estimated losses are about 49% on average.

Water resources used for water supply in this region are varied: abstraction of groundwater in media of intergranular porosity - 49%, of groundwater in media of fracture-karst porosity - 8%; water abstraction from fracture-karst media (sources and springs) - 29%, and abstraction of surface water from watercourses -13% and reservoirs 1%.

The highest water quantities are abstracted by means of wells of groundwater in the valley of the Spreča river (Tuzla canton) and in Sarajevsko polje. As to water abstraction structures most frequent are captures of springs and sources.

The most frequent problem of surface waters quality is turbidity, but also increased contents of organic pollution. Pronounced are the problems of water abstraction of the Bosna river for water supply requirements of the town of Maglaj.

As to groundwaters quality, it is difficult to make a generalized statement, but they can be said to be, together with sources and springs, the best quality water resources. In groundwaters coming from intergranular porosity media (Tuzla region, Odžak, Tešanj and Kalesija) the parameters that most frequently deviate from the permissible ones are iron and manganese, and ammonia. Generally, the best-quality waters are the waters from springs and sources in the region of Central Bosnia Canton which are important resources both in terms of quantity and quality (Kruščica, Plava voda, Fojnica resources). However, if protection measures are not urgently undertaken, quality degradation can easily ensue.

The largest water supply systems are Sarajevo, Tuzla and Zenica. They supply about 560,000 inhabitants with water, or about 66% of the total number of inhabitants covered by water supply systems in the Bosna river sub-basin. At the same time, these are the only water supply systems of regional character.

- The Sarajevo water supply system serves about 350,000 inhabitants which is a very high coverage. It can be said to be well organized and controlled. The total of 84,000,000 m³/year is

abstracted on average from all water sources. The largest quantities are abstracted from the aquifer in Sarajevsko polje (87%), from mountainous springs (13%), and from open watercourses (about 4%). The system is, therefore, 90% a pumping system. The length of water network (primary and secondary) is about 1,000 km, with about 200 km of asbestos-cement pipes. As a lack of reservoir space is evident, activities are being undertaken now to build new reservoirs. In the previous period intensive work was done to create a uniform data base. To that purpose the register of water structures was made. In function is also a telemetric system which enables remote-controlled surveillance and operation of all structures. According to the latest data, the losses in the system are about 63.4 % and are mostly caused by the network status. The development of the town of Sarajevo water supply system runs parallel to betterment of protection of water resources and their protected areas. Raw water is satisfactory in terms of quality and, therefore, only disinfection is carried out in order to maintain drinking water quality. In function are also three water treatment plants in cases of surface water abstraction. (water abstraction structures on the rivers Bosna, Vogošća and Mošćanica). The Public Utility Company in charge of management of this water supply system has a modern laboratory for water quality control and a laboratory for testing and calibration of water meters.

- Water supply of Tuzla and surrounding places is carried out via the inter-municipal water supply system Tuzla – Živinice – Lukavac which covers about 165,000 inhabitants. The basic components of this systems are water abstraction structures: “Sprečko polje” – groundwater abstraction from intergranular porosity media, “Stupari” and “Toplice” – groundwater abstraction from fracture-karst media and the reservoir “Modrac” – surface water abstraction. As the quality of water from source areas is not satisfactory, water treatment is carried out at three plants: “Sprečko polje” (coagulation, flocculation, sedimentation, filtration and disinfection), “Stupari” (filtration and disinfection) and at the newly built plant for treatment of water from the Modrac lake. The capacity of the existing source areas does not meet requirements for water of this region. Apart from that, poor condition of pipelines and structures in the system greatly contribute to low degree of satisfying water requirements. Since this is a big system and since there is permanent soil subsidence in the town of Tuzla, current water losses are 55%. Also to be noted is a high portion of asbestos cement pipes in distribution network, the total length of which is about 630 km. According to available data the total water abstraction is 27,767,000 m³/year. Introducing of additional water quantities from the lake Modrac significantly improved water supply conditions and decreased water reductions to minimum. The protection of source areas remains as a key problem to be solved in future.
- According to estimates from 2007, Zenica has about 127,300 inhabitants and out of that number 90,000 are covered by public water supply system. The total water quantities provided amount to 12,344,220 m³/year, with losses being about 40%. Average specific consumption per inhabitant, according to the estimates of the Utility Company ranges between 180 and 200 l/inhab./day, although this level of consumption is decreased by reductions in water delivery during summer season. The data show that legal persons seem to consume on average 30% of the consumption by households. Zenica uses four main sources of water supply for its system, as follows:
 - (a) System Kruščica (Vitez municipality) with maximum total capacity estimated to be 420 l/s, delivers to Zenica about 300 l/s on average,
 - (b) Babina Rijeka – surface source with maximum treatment capacity of its filtration plant estimated to be 200 l/s. Moreover, records from the last three years show that only 72 l/s are used on average for water supply of Zenica,
 - (c) Well Strmešnjak, with registered capacity of 20 l/s,

(d) Klopče, a natural source with capacity of 5 l/s, but average continuous flow used from this source between 2004 and 2006 did not exceed 2 l/s.

Water quality is, generally, satisfactory, except for occasional hindrances at the open type source – the watercourse Babina Rijeka. There are also problems with turbidity during rains at the source which belongs to the Kruščica source system. That is the consequence of non-implementation of source protection measures (intensive trees felling). The system is provided with telemetric monitoring, and JPKVP Zenica has its own laboratory for physical, chemical and bacteriological analyses of water both at the source and along the distributive network. Water is disinfected by chlorination only, but also possible is filtration at surface water sources (Babina Rijeka). The water distribution system is 30 years old, on average, with certain sections being even older (40 to 50 years). The system is more than 140 km in length and is made mostly of cast iron and steel pipes, without inside or outside protection, except for cathodic protection in some sections.

The Drina river sub-basin:

The Drina river sub-basin in the Federation BiH covers the municipalities of: Goražde, Pale-Prača (FBiH), Foča-Ustikolina (FBiH), Kladanj, Sapna and Teočak. The total number of inhabitants in the part of the Drina river sub-basin belonging to the Federation BiH was, according to the 1991 census 70,527. According to estimates from 2007 about 57,500 inhabitants are living now in this region. The number of inhabitants in Sapna and Teočak municipalities is increased in relation to 1991 (migration of refugees), while the number of inhabitants in the territory of Pale and Foča municipalities in FBiH is decreased. It is estimated that about 29.300 inhabitants or about 50% are covered by public water supply systems. Specific consumption for this sub-basin ranges from 60 to 160 l/inhab./day. The total abstracted water quantities are approximately 7,022,432 m³/year, delivered to population are 983,958 m³/year and 248,268 m³/year to industries and for public consumption. Losses are estimated to be about 82% on average which is by far the highest degree in the Sava RBD for FBiH. Water supply networks are usually in very poor conditions especially because of very old pipes. Activities currently underway in this region are mostly oriented to reconstruction of water supply network aiming at decrease of losses. Noticed are certain fluctuations within the canton and some municipalities in relation to coverage by public water supply systems and their quality. The most densely populated is the municipality of Goražde which despite water abstraction facilities with satisfactory capacities (water abstraction of the Drina surface waters and captures of the capacity of 3-250 l/s), has pronounced problems in water supply. These problems are caused by a poor water supply network and also by frequent interruptions in the work of drinking water treatment plants at the surface water abstraction structures.

The region of Kladanj has inadequate supply, mostly due to the worn-out water supply network - high losses, but also due to water quality problems in the source area in rainy periods, with frequent interruptions in water supply. The municipalities of Pale FBiH, Foča FBiH, Teočak and Sapna are mostly rural areas, with small water supply systems or with systems still under construction.

Two treatment plants for the Drina river water are built in Goražde. Water in these water supply systems is disinfected.

The existing water abstraction structures in this area are groundwater and surface water structures, as follows:

- Fracture-karst media (sources and springs) – 32%, sources with abstraction capacity of 2-50 l/s (regions of Kladanj, Pale FBiH and Goražde)
- The Drina river – surface water abstraction structures (Goražde) – 68%, capacity 30 – 250 l/s
- The reservoir Snježnica (surface abstraction structures) – no data available (the region of Teočak).

The immediate Sava river basin:

The immediate Sava river basin in the Federation BiH comprises the municipalities of: Domaljevac, Orašje, Gradačac, Srebrenik, Čelić, and parts of the municipalities of Odžak and Gračanica which by their largest portion belong to the river Bosna sub-basin. The number of inhabitants in this region according to estimates of the Federal institute for statistics from 2007 is about 135,000. Municipalities Gradačac and Srebrenik are most densely populated and most developed. Public water supply systems cover about 42,200 inhabitants or only about 30%. In the last few years intensive activities have been oriented to elaboration of design documentation and research works for abstraction of additional water quantities, aiming at improvement of the status. The concrete results are still being waited for.

Total abstracted water quantities are about 3,599,760 m³/year. Generally, losses are about 54 %, but the highest ones are in Gradačac, even up to 70% due to a very poor condition of the water supply network. The coverage by water supply systems is poor, but the low values of average specific consumption (about 60 l/inhab./day) do not reflect the actual situation, because specific consumption within individual water supply systems is significantly higher.

The whole region can be said to be oriented by its largest portion to groundwater sources, where water abstraction by wells is presented by 70%, surface water abstraction by 28% (reservoir Vidara – Gradačac) and by captures of sources presented by only 2%. Water quality is typical. In water abstraction from the reservoir where the water quality was bad, it was necessary to build a treatment plant; in the region of Orašje iron is found in groundwaters. The total length of the water supply network is about 150 km, with mostly PVC and AC pipes.

3.4.2.4.2. The Adriatic Sea RBD

The Adriatic Sea RBD comprises the Neretva river basin with the Trebišnjica river, the Krka and Cetina river basins and coastal sea. On the basis of estimates for 2007 the total population in the Adriatic Sea RBD is 369,346 inhabitants distributed per river basins as shown below in the text:

No.	The Adriatic Sea RBD	Number of inhabitants as estimated from 2007
1.	The Neretva river basin with the Trebišnjica	311,262
2	The Krka and Cetina river basin	58,084
	TOTAL	369,346

Public water supply systems cover about 58% of the total population. The same remark as in case of the Sava river basin district can be used here as well, namely, that the coverage by public water supply systems is much better in urban environments or municipal centres than in rural areas. High coverage by public water supply systems is registered in Mostar and Čitluk, while in case of Široki Brijeg, Glamoč and Prozor-Rama that percentage is very low. According to available data, the total water quantities abstracted at the sources for water supply purposes amount to 43,591,478 m³/year.

Further in the text is given a table showing data of abstracted and delivered water quantities per river basins:

The Adriatic Sea RBD	Abstracted water quantities at source areas (m ³ /year)	Number of inhabitants served by water supply systems (inhab.)	Gross specific water consumption (l/inhab./day)
The Neretva river basin with the Trebišnjica	40,626,187	188,056	591.9
The Krka and Cetina rivers basin	1,863,691	23,610	216.3
Coastal area	1,101,600	3,000	1.006
Total:	43,591,478	214,666	556.3

Table 3.4.4: Proportion of abstracted and delivered water quantities per river basins of the Adriatic Sea RBD

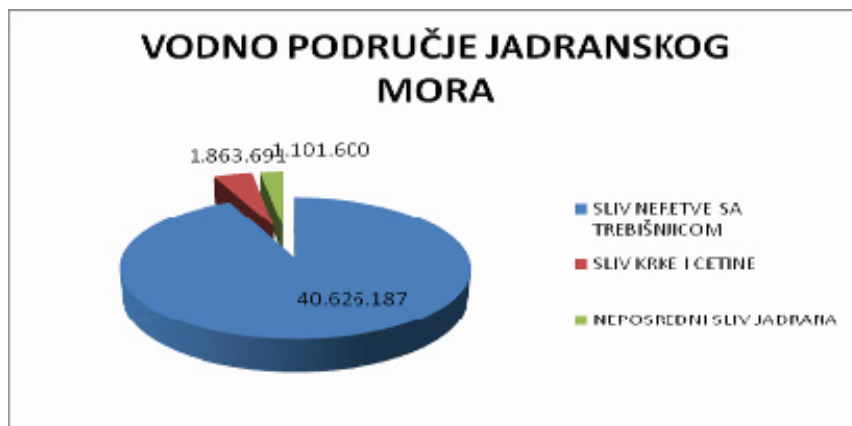


Fig. 3.4.6: Abstracted water quantities per river basins of the Adriatic Sea RBD

Average gross specific water consumption, expressed as a proportion of total abstracted water quantities and total number of inhabitants covered by public water supply systems is 556.3 l/inhab./day. This gross specific water consumption includes: specific consumption by households, specific consumption by industries and institutions, unaccounted for water quantities, or losses. Specific water consumption by population in households amounts to 115 l/inhab./day on average.

With a very high percentage of losses of 69%, the quality of water supply can be considered as unfavourable both in terms of time and consumers' requirements. Frequent reductions, great water losses, inadequate capacity of the source area and worn-out distribution networks are entirely or partly characteristic for almost all water supply systems. In most municipalities water permits for use of source areas are not issued and there is no register of water supply systems.

Structure of source areas used for water supply is as follows:

- Fracture-karst media which occur on the surface in the form of springs and sources 43%;
- Groundwaters from fracture-karst media 46%;
- Open watercourses 9 %;
- Artificial reservoirs and natural lakes 2 %;

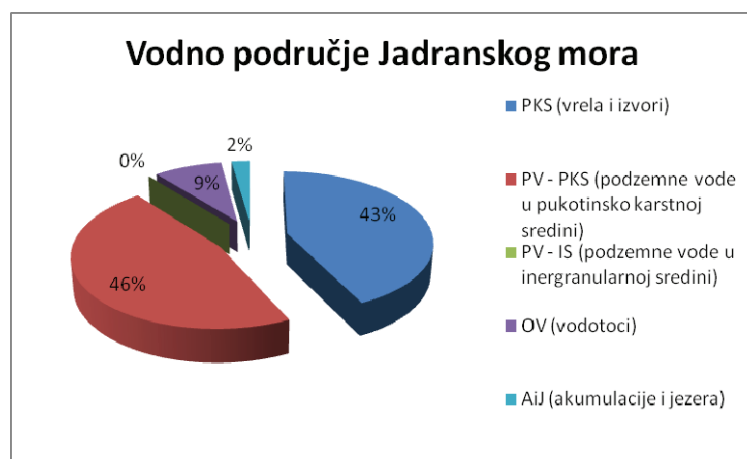


Fig. 3.4.7: Structure of source areas – the Adriatic Sea RBD

Water supply from reservoirs is surely a good solution for regions with inadequate water quantities from other sources. Currently the reservoir Tribistovo supplies the municipality of Posušje with water. Abstraction of groundwater is most represented here which actually is the best-quality water source.

The water quality is good and does not require previous treatment for drinking. Deviations occur usually in heavy rain periods when turbidity at the Radobolja spring is noticed to a certain degree. Only disinfection is applied, and the water treatment plant of the Radobolja spring is used just when required.

The protected areas of sources are mostly non-existent, except for some of them for which protected area I. has been established. Designs have been made for protection of source areas of the towns of: Mostar (the Radobolja, Studenac, Salakovac and Bošnjaci), Čapljina (Bjelave), Grude (Grudsko vrelo), Široki Brijeg (Borak) and Tomislavgrad (the Mukišnica river source).

Overview of water supply status according to river basins of the Adriatic RBD:

The Neretva river basin with the Trebišnjica:

The Neretva river basin with the Trebišnjica river comprises the following municipalities in the Federation BiH: Mostar, Čapljina, Čitluk, Rama, Široki Brijeg, Posušje, Ljubuški, Grude, Jablanica, Konjic and Stolac. The population in the part of the Neretva river basin with the Trebišnjica river which belongs to the FBiH, was according to the 1991 census 359,060. However, according to estimates from 2007, that number is now about 311,000 for this region. Public water supply systems cover about 188,000 inhabitants or 60% of the total population. Gross specific consumption is 592 l/inhab./day on average, but it drastically varies from one region to another (from about 111 l/inhab./day for Široki Brijeg to enormous 1200 l/inhab./day for Prozor-Rama). Specific consumption by population in this river basin is about 118 l/inhab./day. The values of specific consumption for the municipality of Široki Brijeg are significantly lower, being about 43 l/inhab./day.

The total abstracted water quantities from the Neretva river basin amount to 40,626,187 m³/year; out of that quantity 8,091,876 m³/year are delivered for population and 4,018,044 m³/year for

industries and public consumption. Losses are estimated to be 70% on average.. The existing water abstraction facilities in this region cover groundwater and surface water, as follows:

- Fracture-karst media (sources and springs) – 45%, 11 source areas with water abstraction capacity of 60-547.2 l/s (regions of Mostar, Rama, Široki Brijeg, Ljubuški, Jablanica, Konjic and Stolac), Source „DO“ (Stolac municipality) is in the region of the Republic of Srpska.,
- Groundwater from fracture-karst media – 44%, 6 wells with water abstraction capacity of 32-1,000 l/s (regions of Mostar, Čapljina, Čitluk and Grude),
- Artificial reservoirs and natural lakes (Reservoir Tribistovo) (surface water abstraction) – 2% (region of Posušje) Capacity of this water abstraction structure is 90 l/s,
- Water abstraction structures in open watercourses– 9% the Bregava in Stolac and Ljubuški.

As we deal here with springs, sources and groundwaters from intergranular media, the quality can be said to be satisfactory in most cases, so that only disinfection of water is applied. The exception is the place of water abstraction from the Radobolja source (municipality of Mostar) where a water treatment plant is built and foreseen to be used in high turbidity periods. Treatment in this case is carried out by means of quick filters. Protected areas have been defined and established for some sources.

The Krka and Cetina river basin:

The Krka and Cetina river basin in the Federation of BiH comprises the municipalities of Livno, Duvno and Bosansko Grahovo, and portions of the municipalities that belong to this river basin district but are also partly in another river basin district: Glamoč and Kupres. Further in the text, there follows a review of water supply status in all mentioned municipalities because administratively they belong to this river basin district.

The total number of inhabitants in the part of the Krka and Cetina river basin in the Federation BiH, according to estimates from 2007 is about 58,000. Majority of them live in Livno and Tomislavgrad. Public water supply systems cover about 23,600 inhabitants, or only about 40%. Gross specific consumption is 216.3 l/inhab./day, with big differences for various water supply systems, ranging from 48.2 l/inhab./day for Bosansko Grahovo to 316 l/inhab./day for Tomislavgrad. Characteristic for this river basin is, generally speaking, small spatial coverage of population supplied with water from water supply systems, and small totally abstracted water quantities. The total amount of abstracted water is 1,863,693 m³/year, with 636,212 m³/year delivered for population and 288,601 m³/year for industries and public consumption. Losses are estimated at about 50% on average, although for the region of Glamoč they are as high as 70%. Many inhabitants are oriented to individual water abstraction from cisterns and wells and to small local water supply systems. Old and worn-out networks are a weak point of the existing water supply systems, which additionally contributes to the generally poor picture of water supply. Water sources used in water supply systems are:

- Fracture-karst media (springs and sources) – 33%, 9 source areas with water abstraction capacity of 3-150 l/s (region of Livno, Bosansko Grahovo and Kupres);
- Groundwater from fracture-karst media (wells) – 67% (13 water abstraction spots). Water abstraction capacity is 6.5-70 l/s (regions of Tomislavgrad, Glamoč, Bosansko Grahovo and Kupres);

The raw water quality is satisfactory in most cases (springs and sources) so that only disinfection is applied. The protected area has been established in all water abstraction structures in the

municipalities of Livno, Tomislavgrad and Kupres A design for source area protection has been made only for the source of the river Mukišnica.

The immediate Adriatic Sea river basin – coastal sea:

The immediate Adriatic Sea river basin comprises the municipality of Neum. According to available data, it has 4,682 inhabitants with 3,000 of them covered by a public water supply system which is 64% of the total population.

The public water supply system is managed by the Utility Company Neum. Gross specific consumption is about 1006 l/inhab./day. The total water abstracted quantities amount to 1,101,600 m³/year - with 267,289 m³/year delivered to population and 166,856 m³/year to industries. Losses are estimated to be about 60% on average. It should be mentioned here that variations in water consumption in this region within a year are significant because of tourist season in summer months. There are no reductions of water in this area due to satisfactory water quantities.

The existing water abstraction structures in this region cover abstraction of groundwater from fracture-karst media (wells) – 100% (two water abstraction structures). Their capacities are 15 and 200 l/s (Blace, Gabela). The water quality is satisfactory so that only disinfection of water is applied, by means of gaseous chlorine. The protected area I has been established at water abstraction structures in the municipality of Neum.

3.4.2.5. Conclusions

Having an insight into presented data, the following can be concluded:

- Total water quantities required for water supply of population and industries per individual river basin districts do not exceed capacities of potential resources. The same situation is in the entire considered region. In other words, there is enough water to meet requirements for water supply in the plan period. Distribution of source areas and their relationship in view of locations of consumers, i.e. the orientation of consumers towards certain source areas is a subject matter of a separate analysis.
- Total capacities of groundwaters, namely, waters from intergranular and fracture-karst media satisfy requirements. However, this does not mean that there is no need for water abstraction from open watercourses or reservoirs, because of spatial discrepancy between consuming areas and groundwater source areas. But this situation also points to the abundance of this water source and emphasizes the need for its preservation and quality protection.
- The Bosna river sub-basin is singled out as the most interesting area with the highest total requirements. This sub-basin area is characterized by most unfavourable relationship: required vs. available. The total groundwater capacities, estimated to be about 5.9 m³/s, are to a considerable extent depleted by the existing water abstraction structures, up to 82%. A necessity to create multi-purpose reservoirs is expected only in this sub-basin district, with the purpose of water supply as a priority.
- What characterizes the Drina river sub-basin is poor groundwater capacity, which greatly complicates the solution of water supply problems that are related to required treatment.
- Stagnation in water supply systems development is obvious. Its consequences are: out-dated equipment, poor condition of water supply structures, poor situation in terms of water abstraction, numerous bottle-necks in water supply systems which by their capacities cannot meet increasing

requirements by consumers, and inadequate coverage which is especially pronounced in the Adriatic Sea RBD.

- Protected areas of the sources have not been established in a large number of cases. Even where they are established, the measures are usually implemented only in protected area I.
- Water supply systems are organized at municipal level, without being integrated into inter-municipal (with rare exception, as e.g. Tuzla region) or regional systems. As a result thereof, available water quantities at the source areas are unevenly distributed in relation to needs.
- Utility companies in charge of production and distribution of water are still unable to entirely fulfill the set forth tasks. The working out of the register of water structures is going at a slow pace and record keeping of abstracted and delivered water quantities is not systematic.
- Composition of personnel in most utility companies is not in compliance with tasks that are in charge of such companies.
- High water losses are, unfortunately, one of the usual characteristics of most water supply systems.

3.4.3. Water use for industries

The share of industries in total water consumption is important and considerably depends on the development degree of a region for which estimates for water demands are made. A portion of water requirements for industries which in their processes demand water of drinking quality is included under the item of specific consumption by the population. On the other hand, the biggest industrial consumers very often have their own resources of water supply, especially if in their production process they do not need water of drinking water quality.

Quality and quantity of abstracted water for industrial purposes depend in the first place on the implemented technological process which significantly affects, inter alia, the choice of the industrial plant location, the way of water abstraction and possibly its preliminary treatment. Present technologies are, in principle, oriented to reduction of all resources used in the production cycles and to introduction of water recirculation in technological processes wherever possible. Actually, despite the fact that big industries rely on establishing their own water abstraction structures in order to provide required water quantities, they are obliged to pay fees for water use, i.e. for release of used waters. In this way industrial consumers are stimulated to modernize technologies and rationally use resources pursuant to sustainable development principle (IPPC Directive and implementation of BAT– Best Available Technologies): They are doing that, among other things, by manifold use of water in production cycles or by decrease in consumption of water per product unit.

In the previous period, water consumption by industries from their own resources was recorded and presented in annual statistical reports. Measurements of pollution loads produced in water use cycle together with abstracted water quantities were used as a basis for calculation of fees and taxes. It is quite clear that those data drastically differ from the current situation in the field, especially in view of the scope of certain industrial plant production, but also in change of technologies and in change of the purpose of industrial plants. Such data are informative and serve to point out the number of such industrial plants and water quantities abstracted and used in that way.⁷⁸

⁷⁸ Pursuant to Water Law, Article 50, Item: Record keeping obligations it is said:“(1) .” Legal and physical persons abstracting and pumping water, except for general water use, shall keep records of the abstracted quantities of water, and submit the data to the competent River Basin District Agency”.

Industries which in their technological processes do not need water of drinking water quality, meet their water requirements, in principle, by their own water supply structures. This is usually water for cooling or washing for which most industries apply recirculation systems. Sanitary consumption of water in such industries is foreseen in specific consumption of that region. The data on water quantities used by industries from their own water abstraction structures are given below in the text:

River basin/sub-basin	Abstracted annual water quantities in 1,000 m ³ /year up to 1991.	Abstracted annual water quantities in 1,000 m ³ /year In the present period (2007)
Vrbas	17,689.73	10.2
Una, Glina with Korana	36,068.11	0.135
Bosna	249,122.25	58.4
Drina	4,128	32.5
Immediate Sava river basin	50	59
Neretva	45,033	641.87
Cetina	708.47	-
Total:	352,799.56	59,147.70

Table 3.4.5: Review of abstracted water quantities for industries from their corresponding water abstraction structures

3.4.3.1. Water power use

Electrical power consumption is one of reliable indicators that show living standards of inhabitants and degree of a society development. Bosnia and Herzegovina dispose of considerable primary power sources which can be seen from the following:

- Estimated hydro potential is about 6,800 MW, out of which some 35% is used in terms of capacity, or about 38% (about 9,000 GWh) in view of maximum possible electric power generation. According to "Strategic plan and programme of energy sector development in the Federation BiH" (Expert group, February 2008) this is the lowest rate of hydro potential tapping in Europe.
- Balance coal reserves according to the above document are close to 4.0 billion tons.

Rated capacities, power generation and consumption in FBiH show that the share of energy system in FBiH is about 60% of the total energy system in BiH. Electric power in the Federation BiH is generated exclusively by hydro power and coal⁷⁹. The construction of hydro-power structures has considerable effects on the non-power sector where these effects are most often not evaluated, or at least not in the right way. But it can be said that tendency to plan and construct multipurpose water systems has been present for quite some time now, where water power use is only one of the reasons for their construction. The interests by sectors of agriculture, tourism, water and the like are satisfied through such a complex system. Depending on the level of impact on the environment, there are hydro power plants with high dams and microhydro plants.⁸⁰ Hydro power potential for Bosnia and Herzegovina according to the present level of technical solutions for their use is 22,050 GWh. Estimates for the region of the Federation of BiH are 11,987 GWh. (The following table shows hydro-potential per watercourses).

⁷⁹ In energy sector there are two Electrical Industry Companies: JP Elektroprivreda BiH dd. Sarajevo and JP Elektroprivreda HZHB. Dd. Mostar.

⁸⁰ Difference between them is 5MW – European Union, or 20MW –International panel for climatic changes.

Watercourse	Available technical hydro-potential (GWh)	Remark:
Neretva	5,048.21	With tributaries
Vrbas and Pliva	852.1	In the Federation BiH
Una and Sana	1,511.7	Potential of the lower reach of the Una river has not been taken into consideration because it is not investigated well enough
Bosna	1,483.5	
Drina	786.7	In the Federation BiH
Trebišnjica	620	In the Federation BiH
Cetina	594.4	Hydro-power potential from these areas is partly used by the Republic of Croatia
Microhydro plants	1,090	Assessed at about 10% of technical potential because they are not adequately investigated
TOTAL:	11,986.61	

Table 3.4.6⁸¹: Hydro-power potential of the Federation of Bosnia and Herzegovina

In the Sava river basin district there are the following hydroelectric power plants at present:

No.	Name of HPP	Watercourse	Year of operation commencement	Type HPP	Rated power (power MW)	Mean annual production (GWh)
1	Cascades on the Una (Kostela)	Una	1954	Diversion	8.2	27.4
2	Jajce I	Pliva	1957	Diversion	60	259
3	Jajce II	Vrbas	1954	Diversion	30	181
4	Modrac	Spreča	1998	Diversion	2	10
Total:					100.2	477

Table 3.4.7: Hydroelectric plants of the Sava RBD

In the entire *Bosna river sub-basin* the only power plants are the power plant Modrac, microhydro plants (MHP) Hrid, a MHP on the Lašva river and a MHP on the Fojnička rijeka which points to an exceptionally low degree of the total potential use. The Bosna river sub-basin is the largest in Bosnia and Herzegovina and the Bosna watercourse boasts high level of development and urbanization so that one cannot expect construction of important reservoirs there which could be used for water regime management. In the previous period it was planned to build reservoirs with a function of multi-purpose water structures on important tributaries of the river Bosna, such as the Krivaja, Bila, Bioštica, Bijela and Crna rijeka, and Željeznica and Miljacka rivers.

Hydro-power capacity of the *river Vrbas* is used nowadays only by a small portion of about 22% of the total usable potential. It should be noted here that in development plans and Water management plan of the Vrbas from 1989, which dealt with the entire sub-basin, further construction of power-generating structures was planned. The present electrical power structures in the Vrbas river sub-basin are: Jajce I on the Vrbas and Jajce II on its largest tributary, the river Pliva.

The analysis of the conditions of hydro-power plants construction in the *Una river sub-basin* led to a conclusion that it is possible to construct 19 hydro-power plants although there are only three at present (Kostela, Štrbački Buk and Krušnica) which makes the Una river the most unused watercourse with tapping potential degree of 1.7% in view of power generation.⁸²

⁸¹ Data from “Draft Water Management Plan of B-H” separate for FBiH

⁸² In view of water sector, the most used reservoir in this sub-basin is the reservoir of HPP „Ključ“ on the Sana river. Design documentation was made in 1999 for the HPP „Vrpolje“ at the level of a preliminary design.. The HPP „Vrpolje“ was planned then as a multi-purpose structure the construction of which would solve many problems related

The tributary area of *the Drina river sub-basin* in the FBiH covers an exceptionally short section which is not important either in view of power potential or the overall potential of this watercourse. The backwater of the existing HPP “Višegrad” gets into the centre of Goražde. Variants of possible construction of two power plants were analyzed for the upstream reach Goražde – Foča.

In the Adriatic Sea RBD there are the following hydro-power structures:

The only hydro-power plant *in the Krka and Cetina river basin* is the HPP “Orlovac”. A large portion of hydro-power potential belonging to BiH is used in this plant, the turbine house of which is built on the territory of the Republic of Croatia. The reservoir of this plant, Buško blato, is the reservoir with largest surface in Europe. The utilization level of hydro-power in the Krka and Cetina river basin which belongs to the Federation BiH is estimated to be - 59.3%⁸³.

In terms of water abundance, *the Neretva river with the Trebišnjica* is the most important watercourse in the Federation BiH. Four hydro-power plants were built on the very Neretva river. Activities on revitalization of some (older) plants have been undertaken and at some already completed: the HPP Jablanica (increase of rated capacity), also hydro-power plants Rama, Mostar, Jajce I and Jajce II.

No.	Name of HPP	Watercourse	Year of operation commencement	Type of hydro-power plant	Rated capacity Ni (MW)	Mean annual production Eg (GWh)
1	Rama	Rama	1968	Diversion	160	731
2	Jablanica	Neretva	1955	Diversion	170	792
3	Grabovica	Neretva	1982	Run-of-the-river	115	372
4	Salakovac	Neretva	1982	Run-of-the river	210	563
5	Mostar	Neretva	1987	Run-of-the-river	72	300
6	Peć Mlini	Vrlika	2005	Diversion	30	80
7	Čapljina	Trebišnjica	1979	Reversible	440	451
TOTAL:					1,197	3,209

Table 3.4.8: Hydroelectric plants of the Adriatic Sea RBD

After 1996 there were 20 microhydro plants built in BiH (mostly in the Federation BiH) and 40 of them are under construction. About 200 concessions have been granted for this purpose up to now. Most of these small power stations were built by private and foreign investments. Up to 1992 there were 13 microhydro plants made in BiH with the total capacity of about 27 MW which nowadays are the property of electric industry companies. Out of that number about 21 MW belong to the territory of the Federation BiH. Obligations have been defined for electric industry companies to purchase the entire electric power generated from RES (renewable energy sources) and to define prices of take-over on the basis of the valid tariff principle for sale of active energy and other conditions as well. All that represented a strong incentive for investment cycle in this field (especially investment into microhydro plants of the rated capacity of up to 5 MW). As a result thereof, preparations are being made for investment into about 200 microhydro plants (some of which are under construction) with the total rated capacity of 177.44. MW (for which concessions have been already granted).⁸⁴

Microhydro plants owned by the JP Elektroprivreda BiH Sarajevo are located in Bihać- Bihać and Krušnica, in Teočak – Snježnica, Osanica in Goražde, and Hrid and Bogatići in Sarajevo. Apart

to flood protection and to the use of water for meeting requirements in irrigation, biologically acceptable flow, recreation and the like.

⁸³ “ Draft Water Management Plan of B-H”, 1994.

⁸⁴ Data from "Strategic plan and programme of energy sector development in the Federation BiH" "

from these, there is also a number of microhydro plants owned by the third party on the rivers Kozica, Jezernica, Borovnica, Prusačka rijeka and Vrbas.

In the past period the JP „Elektroprivreda HZ HB“ Mostar prepared extensive technical documentation, which was to serve as a basis for planning and construction of hydro-power plants with emphasis on investigation of possibilities for construction of microhydro plants, such as „Water management conditions for power plant construction: The Upper Cetina river basin – Basic data“, JP EP HZHB, Development sector, 2007 and „Water management conditions for construction of microhydro plants: Tihaljina-Mlada-Tihaljina river basin and the Lištica river basin – Basic data“, JP EP HZHB, Development sector, 2007.

3.4.3.2. Water use in agriculture – irrigation

Up to 1992 irrigation systems in BiH covered the total of 19,570 ha: (i) the Sava RBD – 12,600 ha (Semberija - 6,800 ha, central Posavina - 800 ha and Lijeve polje - 5,000 ha) and (ii) the Adriatic Sea RBD – 6,970 ha (The Neretva river basin - 5,540 ha, the Trebišnjica river basin -1,130 ha and karst poljes - 300 ha). Many of the systems were not in function completely. After 1996 the situation got even worse due to war damage and negligence. If the arable land in BiH (without natural meadows) was about 1,100,000 ha at that time, it means that irrigation systems were made on 1.8 % of arable land and that 191,620 ha or 17.4% were to be irrigated.

There are no available data nowadays for the region of the Federation BiH either in relation to irrigated areas or crops that are to be irrigated. According to unofficial information, the present areas covered by irrigation are as follows: (i) the Sava RBD – the total of about 362.5 ha and (ii) the Adriatic Sea RBD – the total of about 1,250 ha. So, according to unofficial data, only 1,612.5 ha or 0.2 % of arable land in the Federation BiH are irrigated in total.

3.4.3.3. Fish farms

Tradition of fish farming and fish consumption has not been deeply rooted in most of the Federation BiH. The present activity in this economic branch is most often reduced to re-activation of small trout fish farms and construction of new, even smaller ones, which are, as a rule, located in upstream reaches of watercourses. A limiting factor in edible fish farming is water quality which is satisfactory only at some reaches. In the whole Bosnia and Herzegovina there are now 35 registered fish farms, majority of them being in the Neretva river basin. Present is tradition in trout farming as the most looked for kind of fish. Other kinds of fish, less demanding in view of water quality, like common carp are reared, as a rule, in fish farms in larger areas, which apart from space also require corresponding water qualities that are occasionally abstracted in certain phases of production.

There is neither review of the status of fish farms nor strategy of this branch of economy development. In fact, water use permits are issued at the level of cantons, without established efficient control of water use.

Considering possibilities and status of fish farming in open watercourses, natural lakes and a number of artificial lakes, we can talk, as a rule, about natural growth with stocking for sport fishing purposes. Reservoirs used for water supply purposes or other single-purpose reservoirs are not suitable for fish rearing because of possible deterioration of water quality and incompatibility of plans of the reservoir use and technology of fish rearing.

3.4.3.4. Water sports and recreation

Water recreation implies bathing, swimming, fishing, rowing, sailing, ice skating and short stays near water like camping, and other forms of shorter or longer stays in the area. Tourism has become attractive recently, especially by offering recreational activities related to water, hunting and fishing. Rafting is becoming increasingly popular, especially in watercourses with big gradient and nice scenery like the rivers Una, Neretva, Krivaja, etc. Natural lakes and reservoirs like Boračko, Jablaničko and Modračko jezero have already become well-known tourist destinations. Unfortunately, they are becoming jeopardized by their unplanned and un-organized use to these purposes. The use of reservoirs for water supply will inevitably bring about significant limitations in the use of these water bodies in tourism and recreation due to implementation of indispensable water quality protection measures.⁸⁵ Water recreation quality depends on water management, climatic, local and other conditions, including topography and beauty of scenery. The following parameters have a strong impact on use of water for recreational purposes: quality, temperature, depth and velocity of water, width of water table, presence of fish, water animal and plant world, changeability of water table, conflict with other water management intentions. Water quality and temperature are the most influential factors which decide whether some water resources can be used to such a purpose and to what extent.

The tradition in use of natural and regulated rivers for sport and recreation has been recently somewhat pushed aside due to changes and adverse occurrences as a result of:

- Decrease of free space immediately along the river channels because of construction of residential and administrative buildings;
- Significant deterioration of water quality in watercourses especially in summer when waste substances concentration is the highest due to minimum flows and when the interest in water recreation is also the highest;
- Leaving of large quantities of waste on the river banks;
- Decrease of flow during summer months due to increase of consumption for other purposes (drastic decrease of water management minimum in watercourses);
- Closeness of intensive traffic (roads and railways) immediately along watercourse channels which results in pollution, noise and general disturbance of natural ambience;
- Uncontrolled extraction of sand and gravel from river beds;
- Decrease or loss of fish stock suitable for sport fishing;
- Regulation of channels of watercourses, channeling – creating of channels when velocities often get increased and water depth and riverbed width decreased;

These and other causes contribute to significant worsening not only of recreation activities but also of ambient characteristics of the channels of many watercourses.

3.4.3.5. Navigation

Generally, little attention has been paid to construction of new and improvement of the existing waterways in the whole of Bosnia and Herzegovina. Small boat traffic used to take place on the Sava river and lower reaches of the rivers Una, Vrbas, Bosna, Drina and Neretva. As to the Federation BiH, navigation occasionally takes place in a reach of the Neretva river, from Gabela to Metković, in the length of 4 km and along the sea coast in the length of 24 km.

⁸⁵ Underway is elaboration of the Strategy of tourism development in the Federation BiH which will provide more reliable data and plans in this field.

A part of the Sava river in the region of the municipality Odžak⁸⁶ also belongs to the Federation BiH. The river Sava is navigable for bigger ships from Sisak up to its mouth. After the downfall of Yugoslavia it became an international river. Nowadays the Sava river is not properly regulated for navigation: on its navigable reach there are sharp bends which slow down navigation; shallows occur during low water level and during high water levels the river destroys the banks and widens the river channel, thus decreasing its depth. Generally speaking, the traffic on the Sava river is for the time being relatively modest. On a small section of the watercourse which belongs to the Federation BiH, it is reduced to a very limited use⁸⁷. In some multi-purpose reservoirs navigation is of local and small-intensity type.

3.5. Water quality protection – the status indicators

3.5.1. Introductory remarks

Legal framework in the field of water quality protection is defined in the Water Law of the Federation BiH⁸⁸, especially in Chapter VI. However, activities related to the environment, health, traffic, power generation, tourism, agriculture, forestry and the like have a great and direct impact on protection of quality-quantity regime of waters so that other specialized institutions and administrative bodies should also be involved in most of these activities when there may be a need.

The lack of by-laws by which obligations and tasks become operational is only a part of the problem in carrying out activities and measures in relation to water protection. Certain strategic documents (Proposal of a plan for managing of water quality protection for the Sava river basin district – part of the Federation BiH, 2000-2002; WQM – Plan of water protection which dealt with water protection from urban waste waters, 2005-07; Living Neretva, underway, etc.), which covered this issue pointed to a bad situation in this field, and highlighted the direction in which activities should be undertaken.

Some obligations in water quality protection result from international contracts and agreements such as: SAA (Stabilization and Association Agreement), ICPDR (International Commission for the Protection of the Danube River), The Sava river commission, MAP (Mediterranean action plan) and other⁸⁹, so that objectives and action plans related to these obligations have to be set out on the same bases and harmonized in their implementation, in cooperation with managing bodies from the water sector in the Republic of Srpska.

⁸⁶ From inter-entity border near Mala Brusnica to the mouth of the river Bosna into the Sava near Bosanski Šamac, and also in the area of the municipalities of Domaljevac, Šamac and Orašje from the inter-entity border near the port in Bosanski Šamac to the mouth of the river Smrdulja to the Sava river near the Village of Vučilovac in the region of Orašje municipality.

⁸⁷ By the end of 2002 an international agreement was signed between the governments of Bosnia and Hercegovina, Croatia and Serbia by which the navigation along the Sava river was legally regulated. Within the work of the Sava river commission and with engagement of the member states, activities are being carried out on elaboration of „Feasibility study and design documentation for renewal and development of traffic and navigation on the navigable way of the Sava river.“

⁸⁸ Official Gazette of the Federation BiH, No.70/06

⁸⁹ For the needs of ICPDR and MAP, reports were made and submitted to relevant international institutions with description of the status and identification of the crucial problems in river basin districts under their competence.

3.5.2. Pollution sources and estimate of pressures

By its character and degree of impact, the greatest pollution is caused by the **point source pollution** from: (i) urban waste waters, (ii) industrial waste waters and (iii) seepage waters from landfills. Apart from these sources also important are the **diffuse sources of pollution** coming from: (i) rural settlements, (ii) agriculture, (iii) forestry and (iv) traffic. There are also a number of pollution sources which at this moment are of minor significance for our regions.

Analysis of pollution sources and estimate of pressures include a number of steps, the most important being:

- Review of all activities that can potentially cause some aspects of pressure on watercourses; also pointing to those pressures and activities which can cause effects that are in conflict with preliminary objectives related to target water quality,
- Estimate of development trends which can possibly contribute to change of the scope of pressures on water bodies. Such analyses are partly related to economic analyses of development trends of driving forces,
- Identification of critical activities and pressures, i.e. of such pressures which unless solved can finally end up in a risk of not achieving good water status.

3.5.2.1. Point source water pollution

Urban agglomerations as significant point source polluters have been quantified and spatially located on the basis of statistical data on inhabited places. It is important to mention here that the good quality collection, drainage and treatment of waste urban waters in the Federation BiH are covered to an exceptionally poor extent.

The lack of a reliable register of industrial polluters and data on pollution load they emit has been compensated for by the use of data of effluent quality investigation occasionally carried out with the aim to define a basis for collection of fees for protection of waters from industries. Thus obtained data imply a great degree of unreliability (one-off measurements, changes in technologies and capacities, discontinuous data collection and the like) and can hardly serve as a starting point for estimates of impact by individual industries.

Pollution loads coming to surface and groundwaters by seepage waters from landfills are least investigated. The only serious attempt in this respect has been made on such a landfill in Sarajevo.

• *Population:*

Pursuant to principles in the Directive on urban waste waters (91/271/EEC), as an integral part of the Water Framework Directive (WFD) and taking into account the present situation in the Federation BiH in the phase of division of pollution by population into various types, the adopted principle is that all places with 2000 and more inhabitants should be considered as point sources of pollution. According to estimates about 1,360,000 inhabitants live nowadays in places with more than 2,000 inhabitants, which represents about 60% of the total current population. This number has, therefore, been classified into point sources of pollution. In this way, it is possible to get close to the total pollution load by population per river basins/sub-basins as shown in the following table:

River basin/Sub-basin	Number of inhabitants	Participation	BOK ₅	N	P
	2007	%	(t/yr)	(t/yr)	(t/yr)
<i>The Sava RBD</i>					
Sub-basin of the river Una with Korana and Glina	302,487	13	6,624	1,214	276
Sub-basin of the river Vrbas	120,868	5	2,647	485	110
Sub-basin of the river Bosna	1,341,727	58	29,402	5,390	1,225
Sub-river of the river Drina	57,526	2	1,260	231	52
Immediate Sava river basin	135,557	6	2,969	544	124
Total the Sava RBD:	1,958,166	84	42,902	7,865	1,788
<i>The Adriatic Sea RBD</i>					
Sub-basin of the Neretva river with the Trebišnjica	311,262	13	6,817	1,250	284
Sub-basin of the rivers Krka and Cetina	58,084	2	1,272	233	53
Total Adriatic Sea RBD:	369,346	16	8,089	1,483	337
Grand-total Federation BiH:	2,327,512	100	50,991	9,348	2,125

Table 3.5.1: Review of total pollution load by population per river basins and sub-basins

It is interesting to mention here, that in places of up to 2000 inhabitants which in the total number of places participate with about 95%, around 40% of the total population live in them. This type of settlements has either experienced a significant decrease of population or has, due to its position, merged with adjacent settlements into a common agglomeration. With a relatively small share in the total pollution load and due to their character, these places are considered as diffuse sources of pollution. About 60% of the population live in places with more than 2,000 inhabitants, participating in the total number of inhabited places with about 5%.

One of the documents used in the analysis of the scope of point source pollution is the report “Statistical annual book for 2006” in which given was the estimate of the number of inhabitants per municipalities in the Federation BiH and also data on sewage systems and production of waste waters on the basis of which it was possible to make an assessment that about 761,000 inhabitants or about 33% of the total number of 2,327,512 are connected to the public sewage systems in the Federation BiH.

Sewage network (km)					
	2002	2003	2004	2005	2006
Total length of closed sewage network	1,943	1,970	2,044	2,059	2,071
Combined system	1,015	1,023	1,032	1,040	1,045
Separate system	928	947	1,012	1,019	1,027
▪ Waste waters	586	542	601	606	613
▪ Storm waters	342	405	411	413	414
Main sewer length	292	292	308	309	310
Number of connections	133,992	134,066	145,092	148,792	152,225
Number of street gulleys	14,027	14,301	14,628	14,635	-

Table 3.5.2: Review of constructed sewage network in the region of the Federation BiH

Further division of urban agglomerations is carried out according to their size, or effluent potentials.

▪ **Industrial polluters:**

As a result of the lack of systematic monitoring of quality and quantity of effluents by industrial polluters, the evaluation of pollution load of certain watercourses was made with data obtained either on the basis of measurements executed for assessment of waste water production by large polluters, or on the basis of estimates made by use of data about type and size of production of certain industries, all that with the aim to establish a basis for charging fees for the discharged waste waters. For the Sava RBD charges for release of waste water in 2007 were defined by investigation of waste water quality for 84 industrial polluters and it was found out that they released the total pollution load of 2,118,468 PE. For the Adriatic Sea RBD measurements of 11 polluters gave the value of total pollution load of 26,593 PE. The above data illustrate a significant decrease of pollution load in comparison with the period up to 1991 in the area related to industrial polluters⁹⁰.

River basin/Sub-basin	Industrial pollutants - measuring PE			Estimate	Total industries
	With preliminary treatment	Without preliminary treatment	Total		
	(PE)	(PE)	(PE)		
The Sava RBD					
The Una river sub-basin with the Korana and Glina	12,683	0	12,683	2,386	4,297
Sub-basin of the river Vrbas	1,442	1,024	2,466	1,831	2,110,662
Sub-basin of the river Bosna	769,792	1,321,844	2,091,636	19,026	6,850
Sub-basin of the river Drina	5,924	486	6,410	440	7,742
Immediate Sava river basin	3,591	1,682	5,273	2,469	2,144,620
Total Sava RBD:	793,432	1,325,036	2,118,468	26,152	2,144,620
The Adriatic Sea RBD					
Sub-basin of the river Neretva with the Trebišnjica	13,128	11,110	24,238	187,642	211,880
Sub-basin of the rivers Krka and Cetina	0	2,355	2,355	3,402	5,757
Total Adriatic Sea RBD:	13,128	13,465	26,593	191,044	217,637
Grand-total Federation BiH:	806,560	1,338,501	2,145,061	217,196	2,362,257

Table 3.5.3: Review of total pollution load by industries per river basins and sub-basins with calculation made on basis of measurements

Comparison of pollution load by population with that by industries leads to a conclusion that the pollution load by industries covered by system of charges for released water and the pollution by population are at this moment almost equal. Taking into account the fact that a portion of industries is not covered by the system of collection of charges for released water, and that waste waters by a part of the population, especially of the part belonging to diffuse polluters, are released into the soil as a recipient, it can be stated that industry is slightly ahead in view of the total pollution coming to waters.

⁹⁰ For a number of smaller industrial polluters, the calculation of pollution load is made by coefficients and it is estimated that their share in the total pollution load is significantly lower than by those whose loads are calculated by measurements.

▪ **Landfills:**

Landfills of solid wastes take a significant place in a group of polluters which indirectly, via seepage waters, emit pollution into surface and groundwaters. Apart from the landfill in Sarajevo with controlled operation and with a treatment plant for seepage water which has been put into a trial operation, other landfills such as landfill Uborak near Mostar, Krivodol, Bosanska Krupa and the landfill in Tešanj could also be used at this moment for solid waste disposal, despite certain drawbacks.

None of the landfills disposes of either established monitoring or accurate data on production of pollution and its impact on change of the status of surface and groundwater quality. Annual production of municipal wastes is about 270 kg/inhab. out of which about 36% of the total quantities are not collected by public utility companies. Sanitary landfills are inadequately regulated and are used for receiving about 40% of the total collected wastes. There are 54 landfills (21 regulated and 33 partly regulated or not regulated at all).

Apart from that, industries contribute annually by additional 1,500,000 tons of wastes. Out of that quantity 10% can be classified as hazardous. Additional pollution load is caused by agriculture which also includes about 4,550,000 t/year of manure that is in quantity of about 80% spread over agricultural land thus becoming a diffuse source of pollution.

3.5.2.2. Diffuse sources of pollution

Diffuse or, non-point sources of pollution which on the territory of the Federation BiH have an important influence on change of water quality are:

- Small places not in the category of point sources of pollution (under 2,000 inhabitants),
- Impact by agriculture,
- Impact by forestry,
- Impact of storm water from traffic arteries,

Diffuse sources of pollution are directly related to human activities such as inhabiting of rural areas and use of land (scattered settlements, agriculture, forestry, transport etc.) and are by their origin of spatial character. A specific feature in the Federation BiH is that majority of inhabitants in rural areas are not covered by sewage systems of any kind. In fact, collection and final disposal of waste waters is reduced to a large number of direct outlets or improperly made septic tanks. Such pollution, therefore, can in the total pollution balance be classified as diffuse source pollution.

To get practical data on pollution load by agriculture, investigations have to be carried out in characteristic spatial units based on available data about the use of agricultural land and impact of these activities on changes of water quality under various hydrologic conditions. These investigations should also include data on plant protection agents, data on natural and artificial manure, as well as other elements which affect production of pollution in a certain area. There is no legal framework in the Federation BiH with which to create prerequisites for implementation of the Directive 91/676/EEC related to protection of water resources from pollution by nitrates caused by agricultural activities.

The agriculture potential is described by the fact that out of total BiH area, the agricultural land covers about 2,600,000 ha (about 52%), while the remaining 2,400,000 ha are covered by forests (about 48%). The total agricultural land is rather similar in the Federation BiH and RS, but taking

into account population of the entities, it shows that in the Federation BiH there is 0.56 ha of agricultural land per inhabitant (0.23 ha of arable land and gardens), while in the RS the situation is slightly more favourable, i.e. there is 0.90 ha of agricultural land per inhabitant (0.46 ha of arable land and gardens).⁹¹

Exploitation of forests and accompanying activities (construction of forest roads, transport/taking timber from the place of felling to traffic arteries, use of machines, establishing of forest building sites, etc) result in increase of erosion and introduction of suspended matters into watercourses. The time of precipitation concentration and of its reaching watercourses is reduced which results in a frequent occurrence of extreme flow values. Also present is danger from transport and storage of fuels and lubricants used for machines on forest working sites, from machine servicing and disposal of used coal.

Depending on the way of origin and mechanism of spreading, the diffuse sources of pollution can result, not only from waste waters from population, agriculture and forestry, but also from water coming from streets and also discharge of surface waters from urban areas (change of qualitative-quantitative run-off regime). There are no experiences of our own in view of the contribution of these pollutants to the water quality status which are based on systematic investigations and monitoring of changes. Therefore, in the forthcoming period various institutions should be involved in order to get a more realistic picture of the situation.

3.5.3. Water quality protection from point source pollution

3.5.3.1. Waste water treatment plant

There are 7 treatment plants for waste waters from population which are at present in function in the Federation BiH. They are in Gradačac, Žepče, Srebrenik and Trnovo, in the Sava river basin, and in Ljubuški, Čitluk and Grude in the Adriatic Sea basin. The plant in Neum can be added to this figure although it is located in the Republic of Croatia. A number of urban waste water treatment plants, which prior to the war were either in function or in final phase of construction are not in operation at present. This primarily refers to the plants in Sarajevo, Trnovo and Odžak in the Sava river basin, and plants in Široki Brijeg and Bosansko Grahovo in the Adriatic Sea river basin⁹². According to estimates only 3% of the population in the Federation BiH is covered by waste water treatment. Should, however, the plants which were in function before the war or in the final phase of construction become operational and in function (Sarajevo, Trnovo, Odžak, B. Grahovo, Široki Brijeg, Grude) that percentage would be 30% (the share of the plant in Sarajevo is dominant here).

What characterizes the largest number of inhabited places in the Federation BiH is non-existence of a unified system of collection (and treatment) of waste waters and also the fact that waste waters and storm waters are most often collected by combined sewage systems and discharged to the closest recipient by the shortest possible way. A part of the population solved individually the issue of final disposal of waste water by collecting them into septic tanks. But these septic tanks are most often made in such a way that their contents gets infiltrated into the underground and overflows into

⁹¹ The use of land in BiH is of pronouncedly extensive nature, with expressed tendencies of inadequately planned and unreasonable approach. Losses of soil are caused in the first place by unplanned construction of residential, industrial and infrastructure facilities, irrational exploitation of mineral raw materials and excessive erosion caused by deforestation and inappropriate treatment on slopes. These losses in the FBiH exceed 3,000 ha per year.

⁹² The plant in Odžak was in 1992 in the phase of completion, i.e. in the phase of equipment installation, so that it has never been put into operation. The construction structures still exist and could be used in the process of reconstruction and revitalization of this plant.

the nearest brook. In this way both surface and groundwaters get polluted. The danger from such a way of release of waste waters is that groundwater resources get most often polluted. Basically both ways of waste water release are uncontrolled, unsustainable and contrary to the principles of sanitation of settlements with consequences that can only vaguely be assessed.

RBD	Name of plant	Built in	Capacity (PE)	Capacity of plants in function (PE)	Treatment degree	Function status
The Sava RBD	Sarajevo	1984	600,000		I & II	Out of function
	Trnovo	1991	5,000		I & II	Out of function
	Žepče	2008	5,500	2,250	I & II	Phase I
	Gradačac	1983	30,000	30,000	I & II	In function
	Srebrenik	2000	12,000	12,000	I & II	In function
	Odžak		10,000		I	Out of function
Total Sava RBD			662,500	44,250		
Adriatic Sea RBD	Ljubuški	1990	5,000	5,000	I & II	In function
	Neum	1989	30,000	30,000	I	In function
	Čitluk	2008	7,000	7,000	I & II	In function
	Grude		2,500		I & II	Difficult functioning
	B. Grahovo		1,650		I	Out of function
	Široki Brijeg	1991	5,000		I & II	Out of function
Total Adriatic Sea RBD			51,150	42,000		
Grand-total Federation BiH			713,650	86,250		

Table 3.5.4.: Review of urban waste water treatment plants

Existence of several outlets into recipients prevents a continuous monitoring of waste water production and effects of possible treatment on improvement of surface and groundwaters quality.

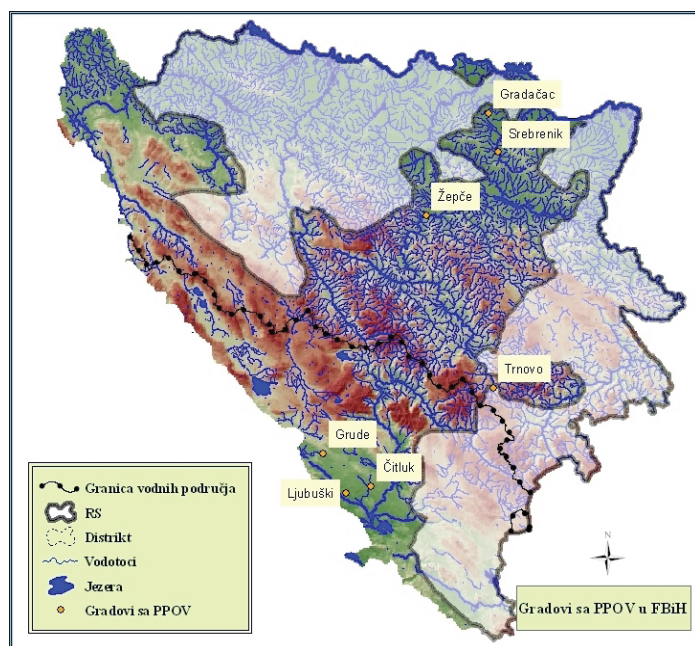


Fig. 3.5.1.: Review of locations for urban waste water treatment plants

There is no integrated review of industrial waste water treatment plants at the level of agencies for the river basin districts, but by control and measurement of PE (population equivalent) it is possible to get some data that can serve as a starting point for estimate of water quality protection measures. It is known at the moment that industrial waste water treatment plants are in operation in the region of the Sava RBD in paper factory in Maglaj, in leather factory in Visoko, in non-alcoholic beverages factory and wire factory in Sarajevo, in factory of car parts in Tešanj, and in a complete complex of chemical industry in Tuzla. However, effects of their operation are mainly unknown. In the Adriatic Sea RBD, industrial waste water treatment plants exist in the alumina factory in Mostar and Široki Brijeg and in the brewery in Grude. Before the war some of these industrial polluters used to have preliminary treatment facilities, but they are now out of function due to either cessation of work of these industrial plants, or inadequate maintenance. Such plants were on the grounds of the factories: “Igman” in Konjic, „Unis“ in Prozor, Buturovića polje, Žitomislić, Mostar and Jablanica, „Famos“ in Ljubuški, etc. Two new industrial waste water treatment plants have been built and put into operation: meat industry “Lijanović” and “Feal”, both in Široki Brijeg.

3.5.4. Water quality protection from diffuse source pollution

Dealing with diffuse source pollution implies a number of measures to be undertaken depending on specific characteristics of each category of polluters: agriculture, forestry, traffic and the like. This aspect has not been legally regulated, for instance, control over products used for protection of plants has not been completely established. In case of road construction, it is necessary in the course of getting a building permit, to solve the problem of collection and treatment of surface waters by means of environmental approval and water approval. But that does not solve the problem related to disposal of water from the existing roads.

Settlements belonging to the diffuse source polluters solve the problem of final disposal of waste waters in an inadequate way, most often by direct discharge into watercourses. Activities related to reduction of pollution load at the place of its origin can significantly help, as well as application of unconventional plants for waste water treatment.

3.5.5. Protected areas

In compliance with the Water Law of the Federation BiH, protected areas have been classified into five groups: the first three are mostly related to the usable value of water, and the remaining two highlight environmental problems, i.e. providing conditions for development of plant and animal aquatic species. According to Art.65 of the Water Law, protected areas are:

- Areas designated for drinking water abstraction;
- Areas designated for protection of economically important aquatic species;
- Surface water bodies designated for recreation, including areas designated for bathing;
- Areas subject to eutrophication and sensitive to nitrates;
- Areas designated for protection of habitats of plant and animal species or aquatic species where maintenance or improvement of water status is an essential prerequisite for their survival and reproduction.⁹³

Such a classification has been harmonized with the WFD, Article 6 of Annex IV in which types of protected areas are defined from the point of view of water management.

⁹³ Described in Chapter 1.2. Natural characteristics

Protected areas designated for drinking water abstraction are defined on the basis of a previous by-law which is to be adjusted to the Water Law; within these activities evaluation of the valid Book of Rules should also be carried out. Some of water supply systems have not a valid decision on proclamation of sanitary protected areas, adjusted to the new book of rules. A good portion of water supply systems have only partially established sanitary protected areas, which in the phase of implementation and control is a very demanding and expensive activity.

Decision on proclamation of sanitary protected areas of the drinking water sources should define the ways of financing and control of implementation of the decision. Adoption of decisions on protected areas is related to administrative borders and can be in competence of authorities from municipal to state (inter-state) level. Decisions on sanitary protected areas are of interest to other sectors as well, especially health, spatial planning and environment, traffic and energy generation, but also forestry and agriculture.

Areas designated for protection of economically important aquatic species have not been defined yet, because corresponding by-laws have not been adopted. Pursuant to Article 71 of the Water Law, it is planned that they be made in cooperation with ministries competent for veterinary medicine and spatial planning. These areas should also be incorporated into corresponding spatial plans.

Areas designated for recreation and bathing are, at this moment, defined according to “The Provision on classification and categorization of waters” from 1980 which is not adjusted to the Water Law. According to this Provision, in the part which defines practical value of water that can be used for bathing and recreation, are classified waters of the so called Category II for which maximum permissible concentration (MDK) of characteristic physico-chemical and biological parameters are prescribed. The competence in the field of monitoring of water quality for bathing is shared by sector of health and sector of water. Bathing places are established by a municipal body in charge of water.

Areas vulnerable to eutrophication and areas sensitive to nitrates have not been defined yet. This will be done after adoption of by-laws, among which the basic one will be passed by the federal minister of the environment. It relates to defining of vulnerable and less vulnerable areas and is in the course of being elaborated. This by-law stipulates measures of protection, prohibition and limitation and regulates monitoring measures (The Rule book on monitoring in vulnerable areas is in the course of being made) and activities. Apart from this by-law, it is also necessary to adopt The Provision on classification and categorization of surface and groundwaters in compliance with the Water Law of the Federation BiH.

3.5.6. Occurrence of accidental water pollution incidents

Accidental water pollution incidents significantly influence the deterioration in quality of both surface and groundwaters, thus jeopardizing aquatic flora and fauna and usability value of water. Most often they occur as a consequence of human activity. Alteration to water quality status can be caused, not only by human activity, but also by occurrence of some natural phenomena, such as extremely high flows, high temperatures of air and water, and the like. A very bad combination is the occurrence of impermissible substances in the period of low waters which only worsens adverse effects of an already negative incident.

Occurrences of accidental and extraordinary pollution of both surface and groundwaters are not monitored systematically. There are no centralized records that could serve for estimate of the situation in this field. Although these issues were dealt with in the old Water Law (Official Gazette of FBiH, No. 18/98), in Articles 124 to 130, there was no system which covered the cases of

damaging, extraordinary and sudden pollution accidents. Solutions were made ad hoc because there is not a routine, prescribed and standardized procedure that could be applied in such cases.

The new Water Law of the Federation BiH deals with this field in Article 61 which in paragraph 9. states that the document in which measures and procedures in case of pollution occurrence are to be defined shall be enacted by the federal minister in charge of the environment, while the federal minister of agriculture, water management and forestry enacts regulation and authorization for legal persons who can be engaged in rehabilitation of consequences of pollution occurrence. Such a by-law has not been adopted yet. It should define procedures and measures to be carried out in cases of the occurrence of this type of pollution. It is still being elaborated and when adopted it will create a realistic framework for more operational activity and monitoring of such occurrences.

In any case, this by-law should define the place where data on accidental pollution incidents could be stored. This would enable easier management of this kind of unwished-for occurrences, focus attention to mechanism of their happening and reduce consequences inevitably caused by such pollution accidents. Such data would be useful for analyses on the basis of which certain statistical indicators, trends and frequency of incidents could be established, as well as the most frequent causes and consequences as a result thereof.

Fragmentary data on some important pollution incidents can be obtained in river basin district agencies, in Federal administration for inspection affairs, police institutions and the like, but there is not one place where such data are collected and processed.⁹⁴

⁹⁴ Accidental pollution incidents in the Adriatic Sea RBD which have happened lately are: pouring out of sub-station oil at the HPP „Jablanica“, occurrence of dye of unknown origin in Konjic on the surface of Jablanica lake (without discovering the perpetrator and without consequences for aquatic living world), turning over of a vehicle for transport of concrete, occurrence of oil and oily water in the Salakovac lake, and oil leak into the Jablanica lake at Čelebici near Konjic. As to the Sava RBD, it is characteristic that the most frequent accidental pollution incidents happened in the river Spreča, downstream of Lukavac. Beside this watercourse, fish kill was also noticed in the river Gnjica downstream of Čelici, in the river Usora and, on the announcement from R. Croatia in the river Sava. Most of these incidents remain at the level of cantonal offices competent for water sector.

3.6. Protection against water – the status indicators

3.6.1. Introductory remarks

Providing protection against detrimental effects of water is one of the basic principles in water management. It is primarily a result of the need to protect people and property and the need to eliminate the consequences of such detrimental impact. Protection of water comprises all measures, activities and actions which in a wider area are planned, undertaken and carried out with the aim to reduce (or eliminate) consequences of detrimental effects of unregulated water regime. Regulation of water courses and other waters include: execution, technical and capital maintenance of regulated watercourses, protective water works and land reclamation systems and other works which enable a controlled and harmless flow of waters and their intended use. Protection from detrimental effects of water includes works and measures for defence from floods (flood management), defence from ice, protection from erosion and torrents, drought control and removal of the consequences of their harmful effects.

Pursuant to the Water Law, surface waters are classified (depending on their importance in water management) into waters of Category I and Category II. Waters of Category I. cover 15 rivers and 5 artificial reservoirs in the Sava RBD (Fig. 3.6.1) and 8 rivers and 8 artificial reservoirs in the Adriatic Sea RBD (Fig. 3.6.2). Natural lakes and wetlands⁹⁵ also belong to Category I, while all other waters belong to Category II.

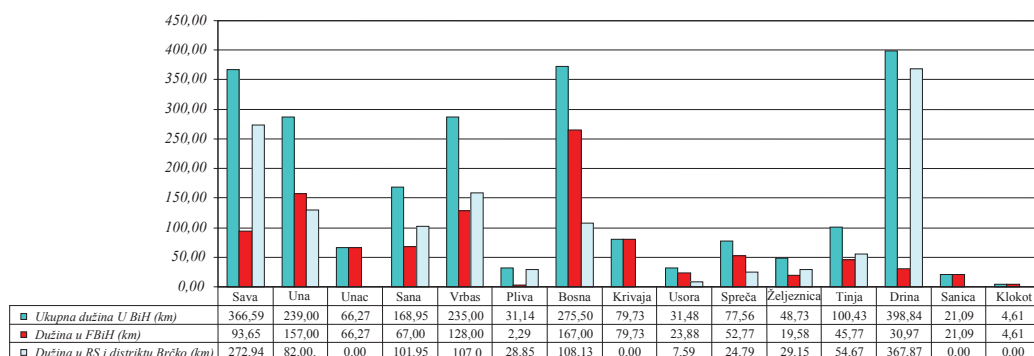


Fig. 3.6.1.: Watercourses of the Category I in the Sava RBD - lengths

Watercourses with water of Category I. in the Sava RBD are: Sava, Una, Unac, Sana, Vrbas, Pliva, Bosna, Krivaja, Usora, Spreča (downstream of the mouth of the Jala), Željeznica, Tinja, Drina, Sanica and Klokot, and artificial reservoirs: Hazna, Vidara, Jajce I, Jajce II and Župica. In the Adriatic Sea RBD the watercourses with water of Category I are: Neretva, Trebišnjica (regulated reach of the stream), Matica (Vrljika), Tihaljina-Mlada-Trebižat, Bregava, Krupa, Lištica (downstream of Široki Brijeg) and Rama, and artificial reservoirs: Rama, Jablanica, Grabovica, Salakovac, Mostar, Buško blato, Mandak and Lipa. Water in natural lakes and wetlands of the region are of Category I, and these are Boračko jezero, Blidinje and Hutovo blato.

⁹⁵ Water Law of FBiH („Official Gazette of FBiH“ No. 70/06) Article 5.

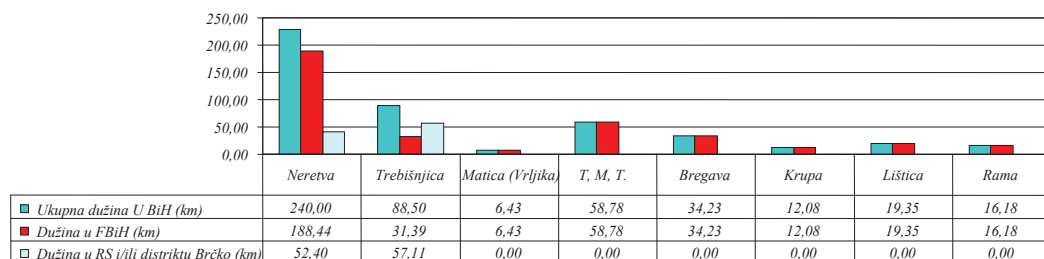


Fig. 3.6.2.: Watercourses of the Category I in the Adriatic Sea RBD

Execution of structures for protection from detrimental effects of water is carried out in accordance with the Plan and programme made by the Government upon proposal by the competent ministry.⁹⁶ Maintenance of watercourses, water property and other protection structures is carried out on the basis of the Plan of regulation of watercourses and other waters which is an integral part of the Plan of water management adopted by the water agencies (The Sava River Basin District Agency, Sarajevo and The Adriatic Sea River Basin District Agency, Mostar), in agreement with the Ministry of agriculture, water management and forestry of FBiH (FMPVŠ)⁹⁷. Decisions on construction of land reclamation systems have been made since 2008 by cantonal assemblies. Maintenance of the systems will be executed in accordance with the Programmes which will also be made by cantonal assemblies. Institutions of water management sector are also in charge of identification and registration of water property and of activities related to extraction of gravel and sand from watercourses, inundations and river mouths into the sea.

3.6.2. The status of the systems for protection against detrimental effects of water

Important works on rivers training, construction of reclamation structures and use of water power in Bosnia and Herzegovina date from the 19th century.⁹⁸ The works on flood control were intensified from the 60-ies to the late 80-ies of the 20-ieth century which considerably reduced damage from flooding and created conditions for intensification of agricultural production and increase of crop yields. The 1991-1995 war activities made great damage to the existing systems. Many structures were damaged, their further development hindered, but the biggest problem is a large number of mines and unexploded ordnance in the considered areas. Despite efforts undertaken and significant improvement accomplished in solving the problem, mines are one of the main obstacles to the safety of the population and to economic and social development of the region. (high contamination in the region of Posavina). Flood control structures and land reclamation systems consist of water structures for regulation and protection from exterior waters and reclamation structures for interior water drainage. Our experiences so far clearly show that even complex flood protection can in some areas be very successfully solved by regulation – equalization of flow. Up to now multi-purpose reservoirs⁹⁹ have been built in Bosnia and Herzegovina with the total volume of 3,851 hm³. For the Federation BiH the following examples should be pointed out:

⁹⁶ Water Law FBiH („Official Gazette, No.70/06) – Article 26.

⁹⁷ Water Law FBiH („Official Gazette, No.70/06) – Article 156.

⁹⁸ In 1887 Prof F.RIEDEL – Report on hydrology of the Trebišnjica – land reclamation of Popovog polja, in 1896. WASSERBAUTEN IN BOSNIEN UND DER HERCEGOVINA, MELIORATIONSARBEITEN UND CISTERNEIN IN KARSTGEBIETE, PHILIP BALLIF, WIEN, 1896; in 1911. eng. Th. SCHENKEL – water power pf the karst region in the south of Austro-Hungarian Monarhy, -hydroenergy use of water of the river Trebišnjica, etc..

⁹⁹ All reservoirs with high dams have well-kept documentation on consequences of possible collapse or spillways over dams in which shown are flood zones , and established public alert systems.

- With construction of reservoirs Rama, Jablanica, Grabovica, Salakovac and Mostar, of the total live storage of about 800 hm³ in the Neretva river valley, the mean maximum flows were reduced by more than 60%.
- The valley of the Trebišnjica river was protected from flooding by construction of the reservoir Bileća, of the volume of 1,280 hm³, including also about 4,000 ha in the Popovo polje which in the past used to be flooded for a long time every year.
- Construction of the reservoir Buško blato, with volume of about 800 hm³, prevented occasional flooding of the area of about 20,000 ha in the Livanjsko Polje.
- In the downstream section of the Sprečko Polje, floods were significantly reduced by construction of the reservoir Modrac with the live storage of 76 hm³.
- Floods are prevented by construction of the reservoir Župica with volume of about 7.7 hm³ on the river Unac (about 17 km upstream of Drvar – first it served for water supply to industries).
- The reservoir Hazna with live storage of 0.5 hm³ and the reservoir Vidara with live storage of 2.8 hm³ on the river Vidara reduce floods in the region of Gradačac.

Land reclamation structures (for interior water drainage) are built in the area of about 70,000 ha, and land consolidation is carried out on about 30,000 ha¹⁰⁰. Drainage systems in the Federation BiH were built with a network of main and secondary canals, pumping stations and other appertaining structures¹⁰¹. For drainage from karst poljes, in the region of the Adriatic Sea basin, five tunnels were built (two in Bekijsko polje, one in Livanjsko polje - energy source, one in Mostarsko blato and one is under construction).

3.6.3. Flood control - significance of floods

Organized approach to solution of problems related to protection of flooded areas (riparian zones of rivers and karst poljes) started in Bosnia and Herzegovina by the end of the 19th century. In the 20-ieth century, until some 15 years ago, protection against floods of urban and agricultural land areas was the main activity of the water sector of that time. Flood control problems in the Federation BiH are specific and complex. They have to be solved systematically with implementation of adequate strategy.

Construction techniques were considerably improved in the second half of the 20-ieth century including the domain of water works. In this way it was possible to efficiently solve the problems of harmful effects of water. Within solution of complex water problems, created were conditions to significantly influence the improvement of naturally unfavourable hydrologic regimes. However, some interventions (especially those that represent partial solutions) were not studied and coordinated in detail, so that they did not give adequate, let alone optimal, effects in the field of protection against detrimental water impact. The problems are getting even more complex in the last few years due to uncontrolled settling of people along river valleys and inundation areas.

Floods are natural phenomena that cannot be prevented, but with timely construction and other activities and measures, arousing awareness of the danger from floods, with higher level of alert, and education of population, flood risks can be reduced to minimum. Floods¹⁰² are dangerous

¹⁰⁰ Situation in BiH before the war

¹⁰¹ The biggest pumping station is Tolisa in the region of central Posavina – Orašje with 15 m³/s.

¹⁰² More than 100 destructive floods occurred in Europe between 1998 and 2004 including disastrous floods in the valley of the Danube and the Elba in summer of 2002 and floods in 2005. The floods pointed to a serious need for

natural disasters which often take quite a lot of human lives, cause priceless material and ecological damage, pollute drinking water sources, bring about epidemic diseases and cause other kinds of damage. Generally, all activities related to protection against detrimental effects of water can be grouped according to types of floods:

- River floods (melting of snow and ice);
- Torrential floods (short-lasting rains of high intensity);
- Floods in karst poljes (inadequate spatial capacity, unprotected lower horizons, heavy rains and snow melting) - creation of natural retention basins;
- Flood by interior waters (polders, wetlands);
- Floods caused by ice;
- Floods in urban areas (limiting factor of storm water collectors);
- Accidental floods (bursting of embankments, dams, occurrence of landslides, occurrence of waters of high order of magnitude).

Flood risks get significantly reduced by construction of protection structures. However, adequate protection of all flood-prone areas in the Federation BiH is still non-existent. Floods can occur at places where least expected, but they can also occur with lower order of magnitude than the protection structures were sized for. A special problem is environmental contamination caused by high waters and possible toxic pollution.

3.6.3.1. Protection structures built in flood-prone areas

Immediate Sava river basin: The northern part of the Federation BiH comprises Odžak area (185 km²) and central Posavina (area of 160 km²) which belong to the immediate Sava river basin. They are protected from floods by polders, the Sava river dike and embankments along the river Bosna (in the length of about 77 km), and by lateral canals (in length of about 22 km). Drainage of polders is carried out by a network of gravity channels when the Sava river water levels are low. In case of high waters in the Sava river, interior waters are pumped over by pumping stations Zorice I and II, Svilaj, Tolisa and Đurići¹⁰³, with total capacity of about 35 m³/s. Inadequate protection level of the considered area is caused by war destruction, large mined areas and by inadequate long-lasting maintenance of the systems. Floodplains are also jeopardized by water from the Bosna river. Reduction of peak flows of the Sava river flood wave in the downstream part in the neighbouring Republic of Croatia plays an important role in protection against detrimental effects of water¹⁰⁴.

The Una river sub-basin with the Glina and Korana rivers: In floodplains of the Una river, in the Federation of BiH, inadequate flood control is evident in places: Kulen Vakuf, Bihać, Bosanska Krupa, Bosanska Otoka, Drvar (Unac), Ključ and Sanski Most (Sana), also Cazin (Mutnica, Toplica, Korana, Kladušnica, Bojna and Glinica). The protection against detrimental effects of water has been solved in most cases only partially: in the Una river by removal or lowering of travertine barriers (downstream of Kulen Vakuf), partial regulation of the Unac, regulation of the Sava river channel in Sanski Most, and regulation of the Mutnica and Kladušnica rivers in Cazin.

protection against detrimental effects of water by concrete actions. The floods have taken a heavy toll since 1998 – 700 lives were lost and at least € 25 billion worth insured property.

¹⁰³ Pumping Station Đurići belongs to the District Brčko BiH, with capacity of 7.5 m³/s, and serves for pumping-over of interior water of central Posavina and controls 67% of its area..

¹⁰⁴ Flood control by low-lying retention basins and expansion areas would create ecologically favourable conditions, that being a reason to proclaim the Lonjsko polje as a Park of nature.

The existing reservoir Župica¹⁰⁵ on the Unac (downstream of Drvar) contributes to regulation of watercourses. In case of high waters, flooded are all valleys, settlements, infrastructure and other structures, and also agricultural areas. Especially endangered are Ripač, Pokojsko Polje, areas in the Klokot valley¹⁰⁶. The Sana river (with the Bliha and Zdena) floods about 740 ha of the area in which intensive agricultural production and urban development¹⁰⁷ are possible. The Lušcipalanačko polje is the only large karst polje in the Sava RBD with all characteristics and phenomena of karst poljes, being endangered by floods from closed karst flood-prone areas. No water control structures have been built in this polje. Damage is caused by high inflow of water during floods. This field is also characterized by inadequate run off by several sinkholes. Out of the total area of the polje of about 2,600 ha, about 1,100 ha get flooded. On the basis of available hydrologic data (previously recorded maximum flows and water levels) it can be said that the highest risk of floods in the Federation BiH is present nowadays in the Una river sub-basin.

The Vrbas river sub-basin: Problems of protection against detrimental effects of water in floodplains of the Vrbas river (in the Federation BiH) occur in places Gornji Vakuf, Bugojno, Donji Vakuf and further on downstream. The concept of protection against detrimental effects of water is based on construction of flood control structures in the channel of the Vrbas river – Gornji Vakuf and Bugojno and construction of appertaining dykes (Donji Vakuf). Bigger damage can be expected in Donji and Gornji Vakuf and Bugojno. In this sub-basin area there are only some individual regulation and flood control structures which cannot provide adequate protection. Flooded areas of the Pliva river are concentrated in a very narrow part of its flow through the town of Jajce.

The Bosna river sub-basin: The river Bosna is the largest right tributary of the Sava river in the territory of the Federation of BiH. Defence from floods was established in large places along the river Bosna: Visoko, Kakanj, Zenica, Zavidovići, Doboj and Odžak. The works on construction of flood control structures have been carried out partially. Often, only one bank was protected, and, as a rule, short reaches were protected due to a lack of financial resources, but that cannot provide adequate protection.

The Bosna river sub-basin comprises the Spreča with the Oskova, Gostelja, Usora and Lašva and watercourses in the Sarajevsko polje. Floodplains of the river Spreča, upstream of the reservoir Modrac, cover about 5,000 ha. Flood control is carried out by embankments sized to waters with the order of magnitude of 1/20. The area around Živinice and the lake Modrac is flooded by high waters from the rivers Spreča and Oskova and backwaters from the lake Modrac. The areas downstream of the reservoir Modrac in which high waters are reduced by the influence of the reservoir itself are flooded less frequently, despite the fact that the problem of regulation of the Jala and Spreča rivers is still present. The Usora Valley¹⁰⁸ ranks as one of the least regulated watercourses with excessive unplanned extraction of gravel which endangers the watercourse and source areas. Also present is flooding of adjacent area. Apart from a risk of flooding the town of Travnik, the river Lašva floods in its course the valley parts of Dolac, Vitez and Stara Bila, and also

¹⁰⁵ The dam and reservoir built to provide water for industry, with total volume of $V=7.7 \text{ hm}^3$, and to provide protection against detrimental effects of water. It is a water permeable karst region in which the problem of water impermeability of reservoirs has never been solved. For efficient protection it is necessary to have the volume of cca 15,000,000 m³ which can be provided by „Župica“ and „Mokronoge“ reservoirs (upstream of Drvar). Overflow weirs – the lateral one completely devastated.

¹⁰⁶ Protection against detrimental effects of water by reducing flooded areas in Bihac – it is necessary to analyze the impact of the travertine barriers and the dam of the HPP „Slapovi na Uni“.

¹⁰⁷ The multi-purpose reservoir „Vrhopolje“ with volume of about 24 hm³ would be very important due to favourable influence on keeping high waters downstream of the Sana.

¹⁰⁸ In 1988. design documentation was made for the reservoir „Marica“ (near the place called Blatnica). It was to provide drinking water for about 15 municipalities of the northern Bosnia.

areas upstream of Han Bila (on the river Bila). In this area there are only individual regulation and flood control structures that cannot provide adequate protection of the flooded areas which are being increasingly developed now (especially the town of Vitez). Sarajevsko polje is endangered by high waters of the Bosna river and its tributaries Dobrinja, Željeznica, Miljacka, Zujevina and Tilava. The damage caused by floods is enormous because it is an urban area (already densely populated and with plans anticipating even further development of the area – of a foreseen industrial zone) The Miljacka river channel is regulated in the length of 10 km. The concept of protection of Sarajevo (from high waters of the Miljacka) has been adopted for the occurrence probability of 1/500 years (although that objective has not been accomplished along all regulated reaches).

The Drina river sub-basin: The only section of the Drina river which is in the Federation BiH is in the region of Bosanko-podrinjski canton. The Drina river originates from the confluence of two streams, i.e. the Piva and the Tara at about 65-70 km upstream of Goražde. A well-remembered is the flood from 1986, when the flow of the Drina river significantly exceeded the occurrence probability of 1/500. The risk of floods has been significantly decreased in Goražde¹⁰⁹ by construction of the reservoir Mratinje (total volume 880 hm³). The works on protection against detrimental effects of water, that is, stabilization of the Drina river channel have been done partially and are not adequate in terms of safe flood control.

The Neretva river basin: The Neretva river is the largest and the most water-abundant river of the coastal, expressly karst, region. The length of the river Neretva is 205.12 km and it crosses two states, Bosnia and Herzegovina and The Republic of Croatia. The upper reach of the river is up to Konjic, the middle to Počitelj and the lower one, called Donja Neretva, from Počitelj¹¹⁰ (downstream of Žitomislić) to the sea, in the length of 36 km. In the reach of the Neretva river downstream of Mostar, up to the border with the Republic of Croatia larger tributaries - Buna, Bregava, Krupa and Trebižat flow into it. In that area are also the towns of Mostar and Čapljina. The floodplains of the Neretva from the mouth of the river Buna to the border with the Republic of Croatia have pronounced karst characteristics in which important surface watercourses are formed.

The section of the Neretva in the Federation BiH, downstream of Mostar up to the border with the Republic of Croatia can be divided into two sub-sections: (i) mouth of the Buna – Čapljina in which no regulation was carried out and no embankments made, although significant areas of construction and agricultural land with roads, residential and industrial structures are endangered there, and (ii) Čapljina-border with the Republic of Croatia which has some flood control structures. Aiming at protection from waters from urban and agricultural areas of the town of Čapljina and the right side bank Gabela-Metković, protection embankments and parapet walls with associated structures (dams, inlets of riparian waters, etc.) were made. Large migration of people happened during the war, resulting in new settlements: Ortiješ, Buna, Žitomislić I, Žitomislić II¹¹¹ and others.

The river Krupa is a left tributary which flows from wetlands Hutovo Blato. It is characterized by large flow profile which enables that even at relatively small de-levelling considerable water

¹⁰⁹ Construction of a number of new reservoirs, especially of the Buk Bijela (upstream of Foča) with total volume of 410 hm³, will significantly reduce the risk of flooding.

¹¹⁰ In the Neretva river basin a number of hydro-power plants with reservoirs have been built (HPP Rama, HPP Jablanica, HPP Grabovica, HPP Salakovac, HPP Mostar and HPP Čapljina) with significant impact on water regime and flood control in the river basin of the Neretva with the Trebišnjica.

¹¹¹ Construction of new settlements considerably disturbed the spatial plans. The structures of new settlements are made in the areas that get flooded already at the probability occurrence of 1/20.

quantities flow from the Neretva into Hutovo blato,¹¹² and the other way round. By hydromelioration works carried out in 1960, the Višička (1000 ha) and Svitavska (1,300 ha) polders were made. In that way considerably reduced was the size of natural retention basin and, therefore, its effects on reduction of flood waves of the Neretva river. Minimum water levels were increased and maximum water levels decreased, which made protection from floods much easier. The problems of flood control in the region of the Neretva river basin are related to the protection of urban agglomerations, tourist areas, infrastructure facilities, agricultural areas, construction of hydro power plants for multi-purpose use of water, but also to a specific nature and phenomenon of *karst poljes*. Risks from floods are present in all karst poljes of the Neretva river basin.

Imotsko-bekijsko (Grudsko) polje is located in the hinterland of Dalmatia, in the northern-western part of Herzegovina covering the total of about 10,059.00 ha out of which 46%, or 4,592.00 ha belong to the municipality of Imotski in R. Croatia and 54%, or 5,467.00 ha belong the municipality of Grude in FBiH. The flood regime is considerably reduced by construction of the tunnel Pećnik in 1951. All waters get collected in the lower part of Imotsko-grudsko polje and form the Nuga retention basin. For flood control of Imotsko-grudsko polje several structures have been built: tunnel Pećnik, retention basins Prološko blato, Nuga and Rastovača, reservoirs Tribistovo and Ričice, drainage channel Grude-Vrlika; regulated were watercourses Vrlika, channel Šipovača, channel Glavine and a number of relatively small watercourses.

Mostarsko blato is by its morphological, geological and hydrologic characteristic a typical karst polje, with the total area of 4,140 ha. It belongs to the Neretva river basin and is relatively abundant with water. A drainage tunnel for waters of Mostarsko blato goes through Varda hill. Duration of floods in the area of Mostarsko blato is directly related to the regime of water discharge through the tunnel Varda¹¹³ and to the channel capacity of the Jasenica. Although about $Q=15 \text{ m}^3/\text{s}$ is discharged through the sinkhole area of Mostarsko blato, floods occur every year but their duration is considerably reduced.

The Trebišnjica river sub-basin in the Federation BiH: The basic concept of water management in the wider area of the river Trebišnjica¹¹⁴ is to enable as long retaining of water on the surface as possible, and thus create conditions for their unhindered multi-purpose use. Meeting water requirements is possible only by construction of multi-purpose reservoirs and artificial watercourses, providing at the same time their water impermeability and by construction of water abstraction facilities for users without higher pumping costs. *The upper horizons* of the Trebišnjica imply a wider area located above the elevation of the existing reservoir Bileća¹¹⁵.

¹¹² On the basis of hydraulic estimates carried out within the Preliminary Design of the HPP Čapljina, the conclusion is that there are good conditions for discharge of water from Hutovo blato into the Neretva and also from the Neretva into Hutovo blato – the Neretva retention area.

¹¹³ Construction of other tunnel is underway.

¹¹⁴ Works on investigation of water regime (natural watercourses and karst poljes) of the region considered as an integral unit have been going on for 40 years already.

¹¹⁵ Elevation of the reservoir Bileća 400 m a.s.l.; upper horizons are: Nevesinjsko, Gatačko, Dabarsko, Fatničko and Bilečko polje.



Fig. 3.6.3.: The Trebišnjica – multi-purpose use of water of upper horizons¹¹⁶ (plan)

The problem of flood control of this area has been finally solved by: implementation of water use system of the Neretva with the Trebišnjica, construction of the reservoir Bileća with volume of about 1,280 hm³, drainage tunnel towards HPP Dubrovnik, reservoir Trebinje I, and regulation of the Trebišnjica channel¹¹⁷ up to an upper balancing reservoir of the reversible hydro power plant - RHE Čapljina in Popovo polje, and overflow weirs with embankments towards sinkholes, aiming at additional discharge of high waters, enabling thus the use of hydro power, increased agricultural production and irrigation.

The Krka and Cetina river basin: Livanjsko polje is in the southeast of the Federation BiH, with the whole area of about 35,200 ha (belonging to the Cetina river basin). Out of that number about 6,200 ha are under the reservoirs Buško blato and Lipa, and hydro power channels network. In the central part of the polje about 14,000 ha are free from flooding. The area of the north-western part is about 15,000 ha¹¹⁸. By construction of a part of the HPP “Orlovac” system in the central part of the polje, floods do not occur here even in case of high waters inflow into the polje. Hydro power channels also serve for protection against flooding. Within the system of HPP “Orlovac” in the central part of the polje built is a balancing reservoir “Lipa” from which water is discharged by a tunnel towards the engine house which is in R. Croatia. Possible surplus is transported by reversible channel “Lipa-Buško blato” into the reservoir “Buško blato”.

Glamočko polje, with Kupreško polje represent the highest karst horizon in the water divide between the Sava RBD and the Adriatic Sea RBD, or the Cetina river basin. All water from highly

¹¹⁶ Source „Trebišnjica- multi-purpose use of water from from upper horizons“-workshop:

¹¹⁷ Length of regulated channel is about 75 km – lining is from shotcrete

¹¹⁸ Čaprazlije about 8,500 ha and Ždralovac of 6,500 ha

elevated parts come to the lowest part of Glamočko polje, creating a retention basin. There are no flood control structures built.

Duvanjsko polje (together with Šujica) covers the area of about 127 km². In the south-east the Šujica sinks into the sinkhole Kovači and reappears at the Livno horizon in Buško blato at the source Ričine. The sinkhole Kovači (with outlet capacity of about 60 m³/s) is the only big sinkhole in Duvanjsko polje, and by its outlet capacity it is the largest sinkhole in the river basin of the Cetina¹¹⁹. High waters inflow exceeds the capacity of the sinkhole resulting every year in creation of a large retention basin before the sinkhole. There are no flood control structures built in the wider area of the Kovači in the zone of pre-sinkhole retention basin.

3.6.3.2. Flood-prone areas

Flood-prone areas¹²⁰ per water areas and certain floodplain areas are shown in the following tables:

Valley of the river	Region	Flooded areas (ha) ¹²¹		
		High waters 1/20	High waters 1/100	High waters 1/500
Sava	Odžak	5.483	6.037	6.348
Sava	Orašje	11.818	12.108	13.052
Una	Kulen Vakuf	230	241	250
Una	Wider area of Bihać	1.054	1.367	1.546
Una	Bosanska Krupa	230	240.7	250.2
Una	Bosanska Otoka	120.4	143.2	165.8
Klokot	Klokot	174.4	174.6	174.8
Sana	Wider area of Sanski Most	491	739	885
Sanica	Sanica	150.9	163	178.4
Vrbaš	Gornji Vakuf	105	151	218
Vrbaš	Bugojno	191.1	230.6	273.1
Vrbaš	Donji Vakuf	26	62.8	108.4
Bosna	Plandište – Reljevo	549.3	611	643
Bosna	Bosna – mouth to the Sava river	655	1.891	2.430
Željeznica	Mouth	20.85	29.23	37.3
Lašva	Travnik, Dolac	22.1	47.2	55.5
Lašva	Vitez	393.1	633.9	826.1
Usora	FBiH	1.303	1.685	1.781
Spreča	Downstream of Modrac	3.125	3.314	3.632
Tinja	Tinja in BiH	106.6	130.9	160.6
Tinja	Srebrenik	353.4	400.9	427.6
Drina	Wider area of Goražde	263.0	304.0	439.0

Table 3.6.1: Floodplains of the Sava RBD

¹¹⁹ The largest sinkhole in the Cetina river basin and in the Balkans

¹²⁰ Data taken from GPP – main prevention plan for flood control in FBiH.

¹²¹ Source of data: „Assessment of the present level of flood control in the Federation BiH and elaboration of improvement programme“ Zavod za vodoprivredu d.d. Sarajevo and Zavod za vodoprivredu d.o.o. Mostar, 2002. The survey, however, does not represent an integrated approach in terms of defining of flood plains. For the Save river basin district, the flood plains were defined for natural status of the river beds, without built embankments; for the Adriatic Sea RBD, however, the flood plains were defined for modified status of the river beds – with existing embankments.

Valley of the river	Region	Flooded areas (ha)		
		High waters 1/20	High waters 1/100	High waters 1/500
Neretva	Border FBiH–HPP Mostar	150.00	205.00	223.00
Bregava	mouth	62.5	66.7	69.31
Trebižat	Mouth – Humac	47.00	47.00	47.00
Trebižat	Humac - Klobuk	157.50	182.00	196.70
Krupa	Krupa	126	127.8	294.1
Mostarsko blato	Flat part entirely – from Uzarića to sinkhole zone in south-eastern part	2,411.50	2,653.00	2,762.60
Imotsko-bekijsko polje	South-eastern part of the polje – zone subject to flooding due to inadequate capacity of sinkholes and the existing tunnel for water release	2,528.00	2,932.00	3,288.00
Duvanjsko polje	Wider area of Kovači – zone of pre-sinkhole retention pond in the southern part of the polje	1,492.00	2,815.80	4,958.00
Livanjsko polje	Wider area of Čaprazlije area of pre-sinkhole retention pond	2,641.00	5,712.00	7,396.8
Livanjsko polje	Wider area of Kazanci – area of pre-sinkhole retention pond	4,277.00	4,735.00	4,976.00
Glamočko polje	Wider area of Mladeškovići – area of pre-sinkhole retention pond	1,239.00	1,325.60	1,716.8
Glamočko polje	Wider area of Pučine area of pre-sinkhole retention pond	1,890.60	2,073.00	2,385.6

Table 3.6.2: Floodplains of the Adriatic Sea RBD

3.6.3.3. Map of risks

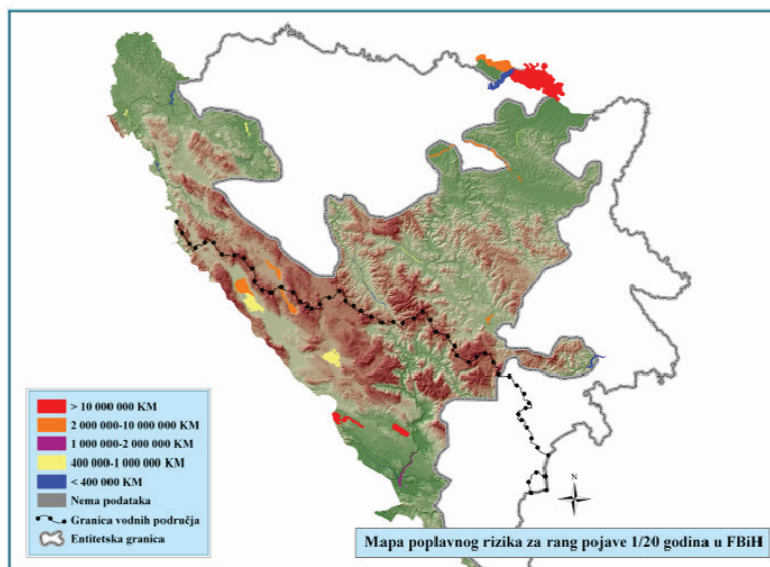


Fig.3.4.6:: Map of flood risks in the FBiH for the occurrence probability of 1/20 years

According to a definition from EU Directive on managing of flood risks, maps of risks represent a synthesis of maps of flooding and maps of potential damage.¹²² Maps of risks help to determine priority measures and generally in the process of creating policy for elaboration of strategy of

¹²² Maps are made on the basis of potential damage and calculated rentability rates. The basis for defining the rentability rate consists of damage (which in the analysis are represented by benefit) and investments provided for construction of flood control structures. . For evaluation of total effects, estimated are average damage values for all endangered areas..

sustainable development in the water sector. Strategy of future investments should be in line with the measures obtained on the basis of maps of floods in endangered areas (map of flood risks) and maps of risks. Fig. 3.6.4.¹²³ shows potential damage in case of high waters of the order of magnitude of 1/20 (also elaborated for high waters of the order of magnitude of 1/100 and 1/500) for endangered floodplains.

3.6.3.4. Administrative flood control measures

According to the Water Law of the Federation of BiH, the Government of the Federation BiH adopts the Provision on Plans for flood control¹²⁴ (The Provision). This Provision stipulates kind, contents and way of elaboration, procedure of harmonizing, adopting, up-dating and keeping of plans for protection against detrimental effects of water in the Federation BiH. Protection against detrimental effects of water is related to defence from floods and ice in watercourses, protection from erosion and torrents and to the measures of protection and elimination of consequences of incidental pollution caused by floods. The Provision established a framework for assessment and management of flood risks with the aim to reduce consequences of detrimental effects of water on human health, environment, cultural heritage and agricultural activities.

Measures, works and other activities undertaken for the purpose of flood control in a certain area of the Federation BiH are defined in a corresponding plan for flood control in that region. Taking into account interdisciplinary and multilateral character and impact of these measures, it is necessary to establish coordination and harmonization of sector policies in view of water management, environmental protection, spatial planning, agriculture, transport and to provide participation of the interested public.

3.6.3.5. Present organization of flood control

The Government of the Federation BiH, on the basis of the Provision on plans of flood control and a proposal by the federal minister of agriculture, water management and forestry issues the Decision on the Main plan of operational measures for flood control at the beginning of every year for the current year. The Main plan of operational measures against floods for 2008 and the organizational scheme for implementation of flood control in the regions of the Sava and the Neretva rivers where water structures are built (property of the Federation BiH) is as follows: The body in charge of coordination and harmonization of the elaboration of the Main plan of operational measures and its implementation is the Ministry of agriculture, water management and forestry of FBiH; data are provided by the Federal Meteorological Institute Sarajevo; the seat of the Ministry of agriculture, water management and forestry of FBiH Sarajevo serves as the operational centre for coordination of key activities of flood control. The organization which carries out all the works related to flood control in the Adriatic Sea RBD is the “The Adriatic Sea River Basin District Agency” Mostar. Director of the Agency is the leading manager of food control. In the Sava RBD in charge of organization of all the works on flood control is “The Sava River Basin District Agency” Sarajevo. The director of the Agency is the leading manager of flood control.

The Centres of flood control are in Orašje and Odžak in the Sava RBD, also in pumping station Svitava, lock chamber “Kruševo” Mostarsko blato and lock chamber “Drinovci” in Imotsko-bekijsko polje in the Adriatic Sea RBD. Warden houses built there serve as flood control field offices.

¹²³ Maps taken from draft GPP-main prevention plan for flood control in FBiH.

¹²⁴ The Provision - „Official Gazette of FBiH, No. 26/09 dated 15th April 2009.

3.6.3.6. Defence from ice

Defence from ice is undertaken when large surfaces of water table get frozen or when ice masses get accumulated or start moving. This can result in danger from floods or damage of water structures and of other permanent or mobile vessels or structures in a watercourse. In areas covered by the Main operational plan, the defence from ice is carried out by the same organization which is in charge of flood control. In other regions, defence from ice is carried out by organizations which are designated by the plan of flood control of these regions. In case of freezing of large surfaces or in cases of accumulation and moving of ice masses, regular or extraordinary measures are proclaimed for that watercourse or a part thereof in order to eliminate harmful consequences. Regular measures comprise observation and registration of the ice occurrence (percentage of covered area of the water table, thickness of ice, height of accumulated ice deposits, and the like.) Extraordinary measures imply undertaking of interventions in the watercourse channel for breaking of ice crust and ice barrier by mining, by means of ice-breakers or in another adequate way.

3.6.3.7. Monitoring and forecasting of hydrometeorological phenomena

To provide operational flood control as efficient as possible, automatic water gauging stations have been established. The Federal Meteorological Institute Sarajevo submits data and reports to the information centres (established within the Sava RBD Agency and the Adriatic Sea RBD Agency). In periods of expected floods, data are submitted on a daily basis from all the stations. At the moment when water levels reach the design values for which defence from floods has to be proclaimed (Slavonski Brod, Šamac Županja, Čapljina, Humac etc.) the data are submitted every four hours until the measures for defence from floods have been revoked.

3.6.3.8. Operational regimes of water reservoir during high waters

Operational regime of water reservoirs is carried out in compliance with “water resource management requirements” stated in „water managing permits” for each and every of the structures until adoption of operational plans by the competent authorities. From the moment of introducing regular flood control measures, the users of water reservoirs submit on a daily basis the data on water levels in the reservoirs, inflow into, and outflow from the reservoirs. In cases of extraordinary defence from floods, the users of the reservoirs are obliged to submit the afore-mentioned data every four hours to the information centres of the river basin district agencies. The regime of charging and depleting of reservoir space foreseen to receive flood waves should be described in detail and represent as such a component part of the Plan of hydro-electric power stations management. The operation of outlet works in case of proclamation of extraordinary measures of defence from floods must be carried out in coordination with competent bodies in the water sector. If reservoir users dispose of data from hydrologic and/or meteorological stations and possibly of remote-controlled information system, they are obliged in case of danger from floods to enable the agencies to have continuous access to such data. On the basis of Article IV b.7. of the Constitution of the Federation adopted is the Law on protection and rescue of people and material property from natural and other disasters¹²⁵ as a plan for protection from natural and other disasters¹²⁶, and elimination of consequences from harmful effects of water. Protection and rescue from natural and other disasters cover programming, planning, organizing, educating and qualifying, implementing,

¹²⁵ Law on protection and rescue of people and material property from natural and other disasters FBiH („Official Gazette FBiH“ No. 39/03 dated 8th March 2003.)

¹²⁶ „Official Gazette of FBiH“ No. 40/08

surveying and financing of measures, and eliminating of consequences of detrimental effects of water.

3.6.3.9. Elimination of consequences of detrimental effects of water

Mitigation of consequences of detrimental effects of water is carried out on the basis of the Programme of rehabilitation. The finances for rehabilitation are provided by the Federation if the damage is made in water infrastructure/water structures (devices). However, should damage be made in water structures which are not the property of the Federation, the necessary resources are to be provided by the owner of the structure. The Programme of rehabilitation is adopted by the government of the Federation BiH, six months after the day of the damage estimate and preparation of the Proposal of rehabilitation programme (adopted by the Commission for damage estimate in accordance with the Water Law and Law on protection and rescue of people and material property from natural and other disasters). Insurance from uncovered flood risks in the Federation BiH is non-existent at the moment, the reason thereof being old habits from the previous social system. The development of market economy and change of ownership relationships are expected to bring about adjustment of competent institutions and application of the mentioned measures.

3.6.4. Protection from erosion and torrents

Hills and mountains in Bosnia and Herzegovina and the Federation BiH cause a large number of torrents (Fig. 3.6.5) of various destructive powers and a possibility of bringing about new erosion processes.

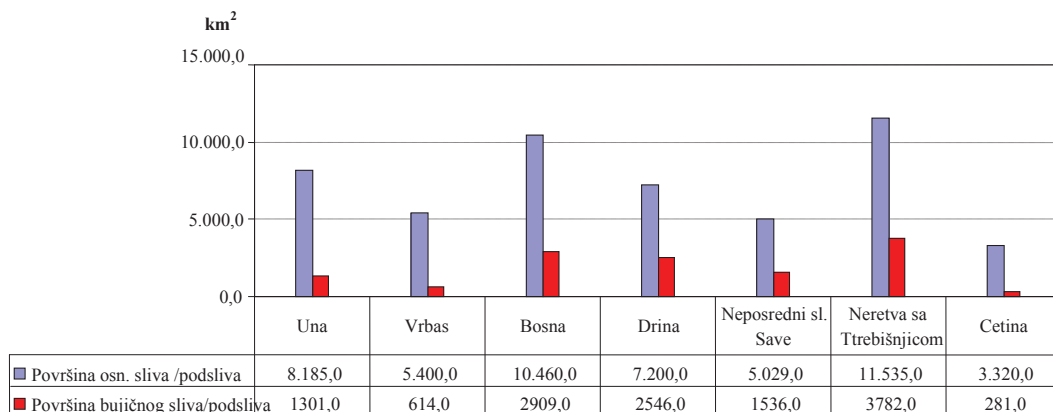


Fig. 3.6.5. Overview of torrential areas in BiH

Intensive erosion and torrents are caused in the first place by relief, geological and pedological features, climate factors, the ways of use of the land and vegetation cover and especially by anthropogenic effects (uncontrolled forest felling, fires, inadequate agricultural production and the like). Erosion processes (Fig.3.6.6) cause great damage, leaching fertile soils on steep, unprotected areas (endangered even today by forest felling) and hilly parts of the river basin, and also reducing agricultural areas, retentive capacity of forests, and retentive capacity of the soils.

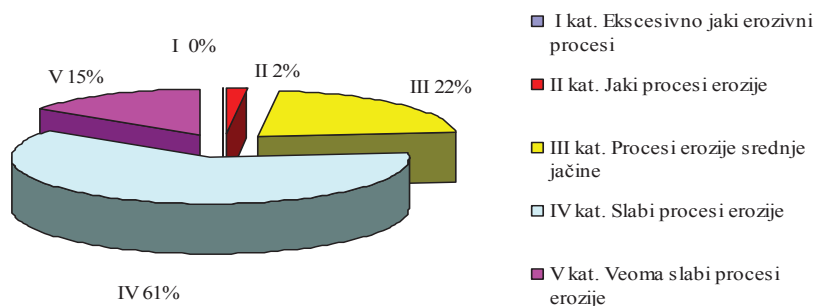


Fig. 3.6.6.: Intensity of erosion processes in BiH

Erosion processes degrade and/or entirely destroy vegetation in the river basin and that results in the occurrence of torrents and ever increasing floods. Morphological characteristics, petrographic soil composition, geological features, lithological and structural material properties, precipitation (as a climate factor), they all have an impact on torrents. Especially great impact is caused by anthropogenic factor (frequent tree felling, fires, cattle grazing, forest clearing for providing arable land, etc), particularly on sloped areas. Economic and social conditions of the society and the man speed up these processes more than all natural factors taken together. Torrents in hilly areas move enormous quantities of sediment which gets deposited in low-lying parts of rivers, reducing their delivery capacity; in reservoirs and retention ponds - reducing their volume; contaminating stored water (water supply reservoirs), thus leading to the occurrence of turbidity and so on.

3.6.4.1. Status of soil erosion and torrents

The status of soil erosion and torrents (Fig. 3.6.7. and Fig.3.6.8.) has a crucial role in the segment of protection against detrimental effects of water in low-lying reaches of a watercourse. Generally, the Federation BiH is affected by various types and intensities of erosion processes and a considerable number of torrents. Covered by erosion is about 90% of the BiH¹²⁷, and according to “The Register of torrents and erosion-prone areas in Bosnia and Herzegovina” there are 935 torrential watercourses, covering the area of 12,969 km².

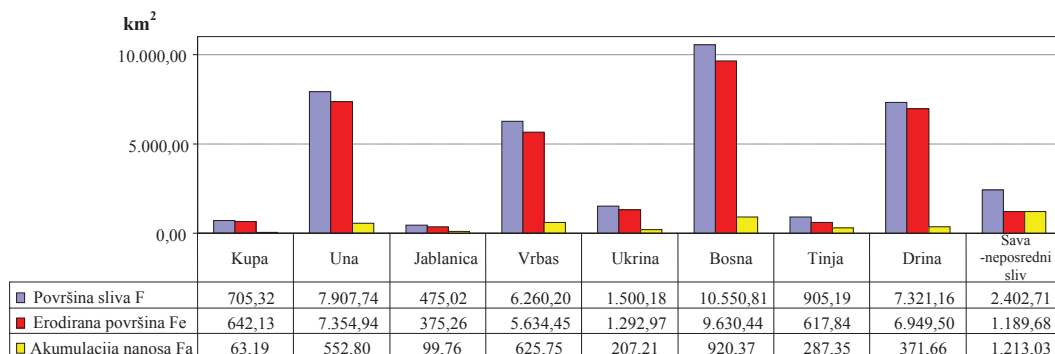


Fig. 3.6.7.: Status of erosion in the Sava RBD in the Federation BiH

¹²⁷ “Draft Water Management Plan of BiH”, Sarajevo 1994..

The works on regulation of torrents and soil protection from erosion have been carried out so far with the aim to protect certain structures, such as reservoirs, high-ways, recipients in inhabited places, etc. Even some specialized agencies have been established for regulation of torrents and protection of soil from erosion¹²⁸.

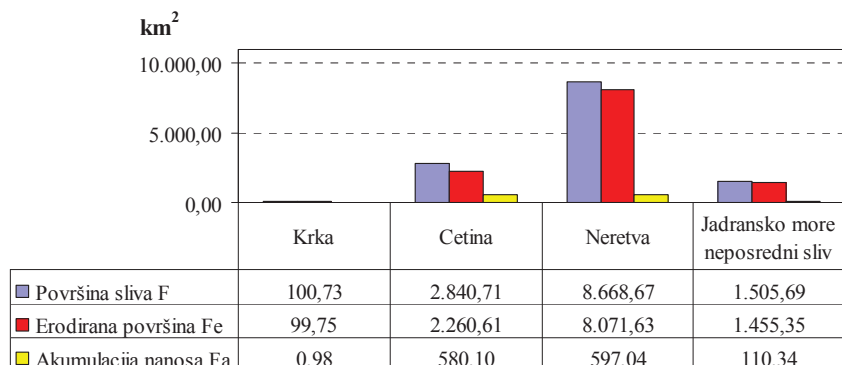


Fig. 3.6.8.: Status of erosion in the Adriatic Sea RBD in the Federation BiH

It should be emphasized here that the problem of erosion must be approached in a more systematic way and with more expertise, because consequences are immeasurable. It is difficult to provide adequate stability and functioning of regulated low-lying watercourses without paying a greater attention and significance to complex regulation of a river basin.

3.6.5. Interior water discharge

The largest portion of fertile land is in the low-lying – hilly regions, above all in the northern part and in hilly-mountainous parts or their river valleys. The altitude of agricultural areas affects mean annual precipitation and temperatures. The average precipitation in Bosnia and Herzegovina amount to about to 1,100 mm with uneven regional and time distribution.

A priority task set out in the medium-term strategy of agricultural sector development is to increase soil fertility by application of agromelioration and agrotechnical measures, and to improve and complete hydromelioration systems in low-lying areas, river valleys and in karst poljes. Since 1991 about 70,000 ha have been drained in Bosnia and Herzegovina. There were also about 30,000 ha of land consolidation areas. Agricultural land represents resources that belong to the whole country and should, therefore, be considered as a production organization which has to be incorporated in spatial plans. Requirements for primary and detailed drainage are, after protection from exterior water and need for irrigation, the elementary conditions and prerequisites for stable and safe agricultural production.

Land reclamation areas have been formed in low-lying parts near the Sava river, in wide lowlands of the rivers Una, Vrbas, Bosna and Neretva, and in closed karst poljes. Systems of interior water drainage in the Federation BiH (Fig.3.6.9) have been completely built by 1991 in Odžak and central Posavina regions and only partially in the region of Bihać, Gornja Spreča, Livanjsko and Imotsko-bekijsko polje and Mostarsko blato.

¹²⁸ The section for river basin of HPP „Jablanica“ accomplished evident results (it started with re-orientation of agricultural production in the river basin).

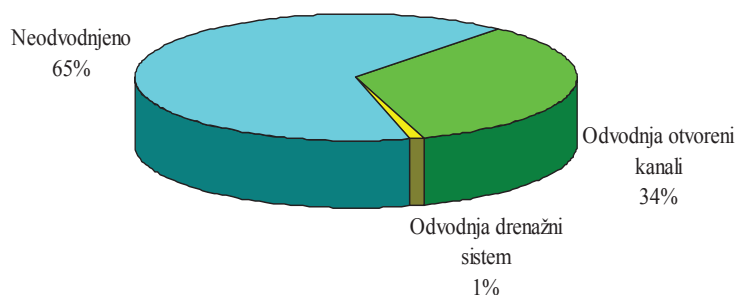


Fig. 3.6.9.: Existing systems of interior water drainage in the Federation BiH

Most of the existing systems for interior water drainage are in poor condition, primarily due to inadequate or non-existent maintenance, war and post-war damage, and even due to general neglect of the state in which these systems are. Contamination of regions and watercourses from mines and the very fact that water carries mines¹²⁹ represent a special problem. Such areas are found in Posavina (central part and Odžak part), Brčko, Bihać, Cazin and other places. Generally, the detailed drainage structures with appertaining facilities (box culverts, pipe culverts, dams, cascades, siphons etc.) have not been maintained according to the law, which is reflected, of course, in failure of the entire reclamation system to function properly. The following table shows degree of accomplished land reclamation structures in the Federation BiH.

Area	Watercourse	Total area (ha)	Drainage (ha)	
			Open canals	Drainage systems
Odžačka Posavina	Sava	18,500	7,800	250
Srednja Posavina	Sava	16,000	16,000	400
The Una river sub-basin	Una, Glina & Korana	18,000	6,000	0
The Vrbas river sub-basin	Vrbas	1,200	1,200	800
The Bosna river sub-basin	Bosna	12,300	7,200	0
The Neretva river basin	Neretva, Krka & Cetina	36,100	13,100	0
Karst poljes		59,410	3,600	100
Total Federation BiH		161,510	54,900	1,550

Table 3.6.3. Data on constructed land reclamation systems in the Federation BiH¹³⁰

Generally, the status of reclamation areas in the Federation BiH is bad, due to fragmentation of land parcels in the first place, but also to war devastation and contamination from mines, a lack of funds and long periods without proper maintenance. It is important to emphasize the need for organization of joint management of land and water within a river basin/sub-basin.

3.6.6. Water scarcity

Water scarcity has been recently a frequent problem. It is necessary, therefore, to establish organized prediction of and protection from its consequences.

¹²⁹ BiH is the most contaminated country with mines in the region of south-eastern Europe. The total suspected area is about 1,889 km² (or about 3.68 % of the territory).

¹³⁰ “Draft Water Management Plan of B-H”, 1994. Sarajevo

Such a situation is caused by scarcity of water in air and soil, by small precipitation quantities and intensive evapotranspiration (very important cause of water scarcity – drought)¹³¹. Water scarcity is considered to be a natural disaster with the most serious consequences. Its impact on the environment and consequences reflected on socio-economic trends, disturbance of the system balance, on food production and other impediments can be disastrous. The plans for prediction and prevention of droughts should be incorporated into the plans of general natural disasters, i.e. into the action plans of flood control¹³², or into the plans of water management. Agriculture suffers most from droughts.

3.7. Bases for reporting on the status of environment in the Federation of BH

3.7.1. Introduction¹³³

Based on consideration of the European Environment Agency – (EAA) on how to proceed with the development of a strategy for Integrated Environmental Assessment, RIVM¹³⁴ proposed the use of a framework, which distinguished driving forces, pressures, states, impacts and responses. This became known as the DPSIR framework for integrated reporting on state of the environment widely adopted by the EAA. This framework enables policy makers on the basis of indicators of the present state of the environment to make decisions for acting in future and to define the order of targets.

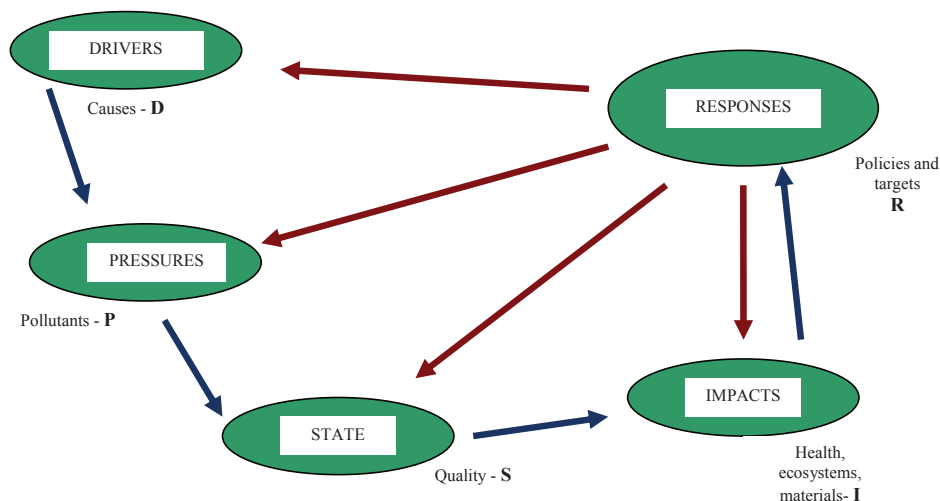
According to the DPSIR framework there is a chain of causal links starting with „driving forces“ (economic sector, general human activities) through „pressures“ (pollution emissions), to „states“ (physical, chemical, biological) and „impacts“ on ecosystems and human health, leading finally to political „responses“ (prioritisation of answers, target setting, indicators of successful target accomplishment and the like). General DPSIR assessment framework has been presented in the following graph.

¹³¹ Droughts are defined (by the World Meteorological Organization) as a period with precipitation lower than 60% of the average in relation to the average of the region (a part of the area that covers at least 50% of the considered region).

¹³² Related to them are plans of irrigation.

¹³³ Used material: The DPSIR Framework, by P. Kristensen, National Environmental Research Institute, Denmark, Department of Policy Analyses. European Topic Centre on Water, European Environment Agency, 2004.

¹³⁴ National Institute of Public Health and Environment, Bilthoven, Netherlands



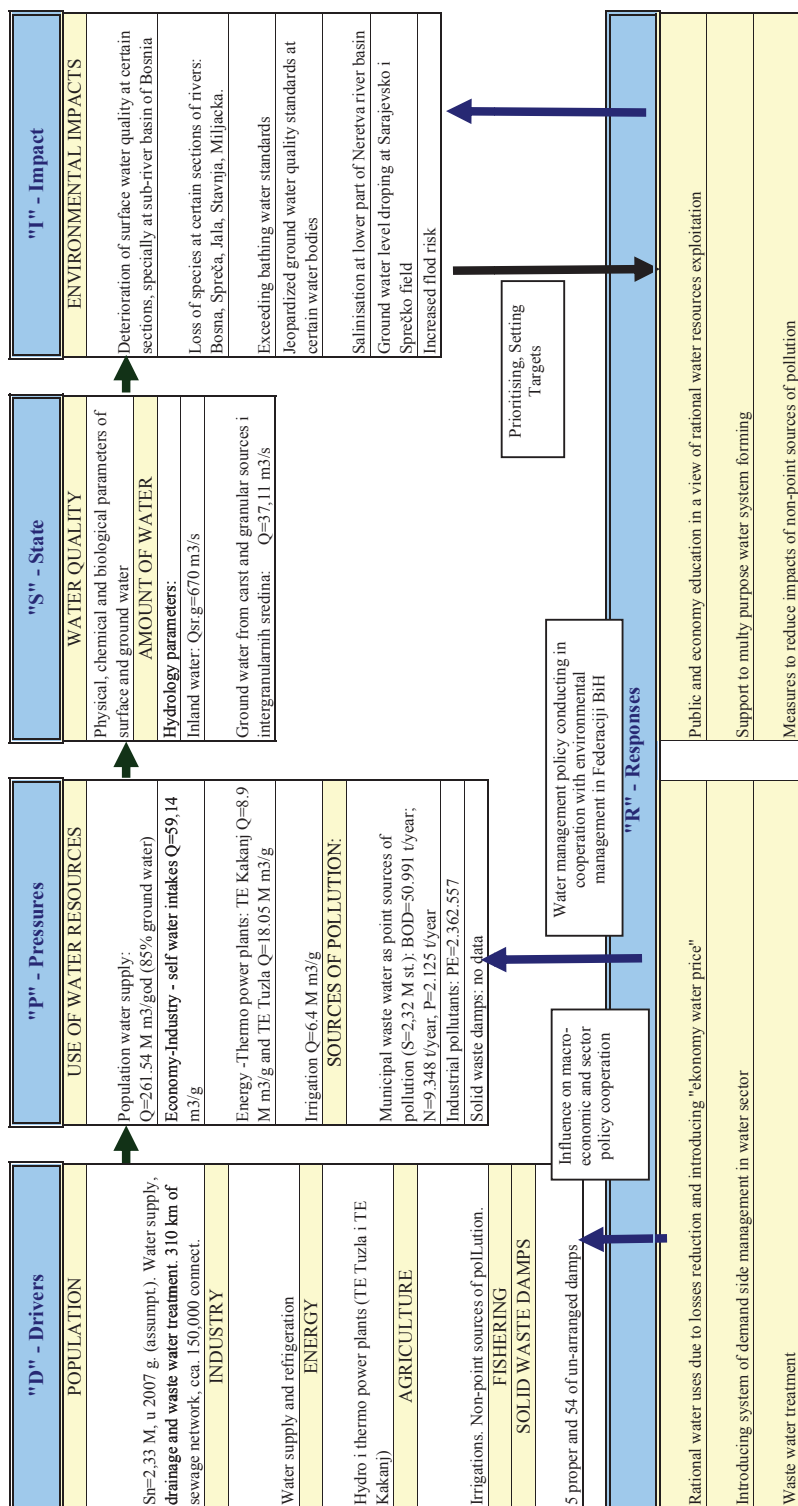
3.7.2. Linking DPSIR elements-indicators

The DPSIR framework is very useful in describing the relationship between origins and consequences of environmental problems. For instance, the relationship between the „D“ and the „P“ by economic activities is a function of the eco-efficiency of the technology and related systems in use, with less „P“ coming from more „D“ only if eco-efficiency is improving. Similarly, the relationship between the Impacts on humans or eco-systems and the „S“ depends on resistance of the eco-system. Depending on how the „I“ (impacts) is understood, perceived and evaluated by decision makers, the results of the applied Responses („R“) to the Driving forces „D“ are more evident.

3.7.3. DPSIR method in relation to water management issues

One of the aims of managing water resources is to safeguard human health whilst maintaining sustainable aquatic and associated terrestrial ecosystems. It is, therefore, important to quantify and identify the current state of, and impacts on, these systems in order to be able to assess changes with time. In water assessment at global, national and by river basins level the answers to the following questions should be defined: (i) *state of water* (water balance and quality indicators); (ii) *time trends* (better or worse state within or outside agreed limits); (iii) *causes of problems* (pressures on the environment – by human settlements, industry or by agriculture); (iv) *results of carrying out of action plan policy* (are results working towards targets accomplishment).

In following figure 3.7.1., DPSIR framework for the Water Management Strategy of the Federation of BH is presented.



4. Water Management Objectives and Measures

4.1. Starting Points in Defining the Water Management Objectives

4.1.1. General Public Health Threat Level

One of the objectives of water management is to ensure the required quantities of water of appropriate quality for different purposes, which is, in addition to being stipulated in the Law on Water¹³⁵, implied by the public social interest: preservation and promotion of the good general health situation of the population. The main indicators of the general health situation of the population, from the water management point of view are as follows:

4.1.1.1. Population Covered by Public Water Supply System¹³⁶

The coverage of population by public water supply system is usually expressed in percentages with respect to the total population residing on the relevant territory. On the territory of the Federation of BiH, the public water supply system serves mainly the residents of the municipality centres, and possibly, suburban settlements attached to the city water supply systems. With regard to the river basin districts, the average proportion of the coverage of population by public water supply systems within the Sava River Basin District is 60%, and for the Adriatic River Basin District, it is 58%. At average, this proportion in the Federation of BiH is around 60%¹³⁷.

Comparing these with the data applicable to Bosnia and Herzegovina indicates that the trend of gradual increase in the proportion of population coverage, which was established in the period 1971-1981-1988, has been stopped. In the aforementioned period, this proportion was increased from 31% in 1971 to 47% in 1981, only to reach 56% in 1988¹³⁸. Even with these figures, Bosnia and Herzegovina was on the penultimate place in the former Yugoslavia. A comparison with the population coverage figures in the neighbouring countries is the best indicator of inferiority of our country and the Federation of BiH when it comes to water supply system development: Croatia - 76%¹³⁹; Austria - 86%; Czech Republic - 87%; Slovakia - 83%; Slovenia - 85%; Hungary - 92%.

The average specific water consumption, at the population level (households and institutions, excluding industry and losses) in the Federation of BiH is approximately 120 l/inhabitant/day. This unfortunately does not indicate that the rational water consumption is in place, as it is the case in the majority of the developed European countries, but that there is a lack of water in certain areas.

4.1.1.2. Population Covered by the Drainage¹⁴⁰ and Waste Water Treatment Systems

The organized systems for collecting and draining waste water are mostly concentrated in the municipal centres; however, as opposed to the water supply system, the proportion of coverage by

¹³⁵ Article 22, Law on Water of the Federation of BiH: Water Management objectives

¹³⁶ Article 4, Law on Water of the Federation of BiH: "Public water supply" means the activities of abstraction of ground or surface waters for the purpose of securing water supply for the population; of water treatment up to the safety degree and of providing piped water supply to the consumption point and its distribution to water users, if the total abstracted volume of water exceeds 10m³ a day;

¹³⁷ As stated above, these data refer to the total population. The coverage in the municipal centres varies between 94 and 98%.

¹³⁸ Long-Term Programme for Drinking Water Supply for the Population and Industry SR BiH, Water Management Institute Sarajevo, 1988

¹³⁹ Water Management Strategy of the Republic of Croatia, Draft, 2007

¹⁴⁰ This term refers to the systems for collecting and draining the urban waste waters and the authorized organization is competent for maintaining this system.

these systems is significantly lower. According to the estimates applicable to the Federation of BiH, this proportion is around 33%, i.e. these systems cover a total of around 761.000 inhabitants.¹⁴¹ The waste water recipients are surface waters. The total length of the sewage network is 2,071 km, i.e. 2.72 m/inhabitant.

The municipal waste water is almost entirely discharged into the recipients without any treatment. The current situation is such that only the waste water produced by 44,500 inhabitants is treated, which is only around 1.9% of the total population of the Federation of BiH.

4.1.1.3. Surface Water Quality

Generally speaking from the aspect of general health situation of the population, the quality of the surface water on the territory of the Federation of BiH is *threatened*, and in some watercourses or parts thereof, it is seriously *undermined*. This is, obviously, related mainly to the area of the River Bosna sub-basin, where the quality of surface water is the worst. The major causative agents of the pollution are municipal waste waters produced by the inhabitants, as concentrated polluters, (22 agglomerations with over 10,000 inhabitants¹⁴²). The effects of industrial pollution, expressed in *the equivalent number of inhabitants* totals around 2,400,000. The adverse effect of surface water pollution on the health of population is potentially multiple and it is reflected in the impact it produces on the quality of drinking water resources, water required for irrigation, recreation, etc.

4.1.1.4. Groundwater Quality

The existing structure of the groundwater resources being used for supplying water to the population is such that their share in the total volume of the abstracted water is 85%. The groundwater from fracture karst areas that are particularly susceptible to pollution, make 52%. It is obvious that the major adverse effects on the population health safety are reflected in the threats to drinking water sources. The protection of these sources is defined in the applicable Rulebook¹⁴³, stipulating technical and administrative measures that should be taken for the purpose of water quality protection. Unfortunately, the full implementation of these measures is not in place.

Systematic observations of the groundwater quality have not been implemented, but the conclusions about the quality of this water resource may be drawn from the data on the quality of water being abstracted for the needs of supplying water to the population. According to these data, it may be concluded that the quality of groundwater resources is still, generally, good. Majority of this water being used for water supply does not require an additional treatment, save for the mandatory disinfection. In the groundwater from intergranular zones in the area of the River Bosna sub-basin and the immediate Sava River basin (Sprečko polje, the area surrounding the City of Orašje), there is evidently presence of dissolved ions of iron and manganese, and in certain zones nitrate ions, as well.¹⁴⁴ In the recent years, there has been an adverse trend of deterioration of water quality in the sources from fracture karst areas, mainly as a result of imprudent activities in the associated catchment areas, which caused the necessity of building the conditioning facilities.

¹⁴¹ The status of these sewerage systems is subject to a separate analysis which includes its warn-out condition, maintenance quality and the locations and the number of outlets into the recipients.

¹⁴² Data source: „Water Quality Management at River Basin Level in Bosnia and Herzegovina“, Carl Bro and REC, 2007

¹⁴³ Rulebook on Conditions for Identifying the Sanitary Protection Zones and Determining Sanitary Measures for the Sources that are used or Intended to be used for Drinking, Official Gazette of FBiH No. 51/2002.

¹⁴⁴ The population in the area of Šamac and Orašje has been threatened by endemic nephropathy for a long period of time. There is no scientific proof that this disease is connected to the quality of groundwater, although there are certain suspicions that this might be the cause.

4.1.1.5. Effect of Floods

Floods, being a natural phenomenon, have an adverse effect primarily on the safety of the population and resources. However, the consequences that floods leave behind affect the health condition of the population through pollution of drinking water resources or by disabling the water abstraction for water supply. Floods represent the biggest threat to the groundwater resources from intergranular areas (33% of the water resources used for supplying water to the population), because they are situated in the river alluvial deposits.

4.1.1.6. Conclusion

The above-mentioned general indicators of the population health safety in the Federation of BiH show that it would be necessary to increase the level of investments, and particularly and primarily raise public awareness of the current situation. As it is already stated above, the water quality at water intake facilities is mostly good, but it will certainly be increasingly smaller number of high-quality water resources if this process of water polluting continues or intensifies and unless the source recharge zones are protected. Only on these grounds, it will be possible to start increasing public water supply coverage.

A separate matter is related to the organization of public utility companies entrusted with the water abstraction and distribution activities, as well as the activities of collecting, draining and in rare cases, treatment of waste water. The operations and organization of these companies fall under the competence of the municipalities or Cantons, i.e. it is mainly concentrated in municipal centres. For this reason, there is an imbalance in the levels of organization and development. Therefore, it will be necessary to initiate the processes of organized merging of several public utility companies on the basis of economic, technical and other requirements, all for the purpose of rationalization of operations, improvement of service quality and increase of coverage.

4.1.2. Safety of Population and Resources

The safety of population and resources in water management sector is reflected in the degree of protection of area covering the Federation of BiH against adverse effects of water, such as: floods, ice-caused floods, erosions and torrents. The area covering Bosnia and Herzegovina, including the Federation of BiH, has been for the most part spared of large-scale floods in the recent years. However, it should be taken into account that the European countries were subject to more than 100 devastating floods only in the period between 1998 and 2004, leading to around 700 human casualties and taking away around 25 billion Euros of secured funds. This and similar examples show the gravity of the need for protection against detrimental effects of water by taking concrete actions.

The current situation with respect to the status of the facilities for protection against water is such that primarily due to the financial situation, it is not even possible to carry out the regular maintenance.¹⁴⁵ This situation is the main reason for the unsatisfactory protection against detrimental effects of water with high risks of floods, unfinished and unmaintained melioration systems and only partially remedied war damages.

¹⁴⁵ The exceptions are the areas of Odžak and Middle Posavina where the system for protection against floods is maintained on a regular basis and to the required extent (apart from the embankment slopes in the sections that have not been demined yet).

4.1.3. International Commitments and Agreements

The international water management framework is defined by geopolitical position of Bosnia and Herzegovina, i.e. by its affiliation to the countries of Mediterranean, i.e. the Adriatic Sea basin, as well as the countries of the Danube river basin. The position of Bosnia and Herzegovina on the Western Balkans territory, i.e. its affiliation to the group of countries aiming to become EU Member States, most clearly determines the ultimate framework in the water management sector.

4.1.3.1. European Water Management Framework¹⁴⁶

The process of development of the European water legislation has been underway for almost 30 years. In the beginning, the EU Member States adopted the quality standards for surface water being used for the public water supply. Subsequently, the mandatory drinking water quality objectives and the regulations on water quality for farming fish and shellfish, bathing water and groundwater were adopted.¹⁴⁷ The second stage of the development of water legislation was based on the conclusions drawn at the 1988 Community Water Policy Ministerial Seminar when the need for adopting EU regulations on *ecological water quality* was discussed, i.e. the request was to put forward the proposals for improvement of the ecological quality of surface waters in the EU countries. This decision resulted in new water directives introducing mandatory biological treatment of waste water (or higher degree, if necessary) as well as the control of water pollution with nitrates from agricultural land. Water pollution from large industrial plants was regulated in 1996, while the reviewed drinking water standards were published in 1998.¹⁴⁸

After completing the consultation procedure, a consensus was reached regarding the need for adopting a single framework legal instrument that would replace the current fragmentary policy in the EU water sector, which resulted in the proposal of the Directive establishing the framework for the European water policy. Finally, the EU Water Framework Directive entered into force in 2000.¹⁴⁹

The purpose of this Water Framework Directive (WFD), as set out in Article 1 is *to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater*. The WFD is the main legal instrument that is expected to: prevent further deterioration and protect and enhance the status of aquatic ecosystems, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems; promote sustainable water use based on a long-term protection of water resources; enhance protection and improve the aquatic environment; and contribute to mitigating the effects of floods and droughts.

¹⁴⁶ The following publication used: EU Water Framework Directive, Novi Sad, 2005, Editor: Dr Slavko Bogdanović

- ¹⁴⁷ Directive 76/464/EEC of 1976 on pollution caused by certain dangerous substances discharged into the aquatic environment,
- Directive 82/176/EEC of 1982 on limit values and quality objectives for mercury discharges by the chlor-alkali electrolysis industry,
- Directive 85/513/EEC of 1983 on limit values and quality objectives for cadmium discharges,
- Directive 84/156/EEC of 1984 on limit values and quality objectives for mercury discharges by sectors other than the chlor-alkali electrolysis industry,
- Directive 84/491/EEC of 1984 on limit values and quality objectives for discharges of hexachlorocyclohexane,
- Directive 86/280/EEC of 1986 on limit values and quality objectives for discharges of certain dangerous substances included in List I of the Annex to Directive 76/464/EEC
- ¹⁴⁸ Directive 91/271/EEC of 1991 concerning urban waste-water treatment
- Directive 91/616/EEC of 1991 concerning the protection of waters against pollution caused by nitrates from agriculture,
- Directive 80/778/EEC of 1980 relating to the quality of water intended for human consumption
- Directive 2007/60/EZ of 23 October 2007 on the assessment and management of flood risks
- ¹⁴⁹ Directive 2000/60/EC

The WFD is based on the main principle according to which *the river basin*, being a natural hydrological complex, is considered *an appropriate administrative unit*. Member States shall identify the individual river basins laying within their national territory and ensure the appropriate administrative arrangements, including the identification of the appropriate competent authority for the application of the rules of the WFD within each river basin district laying within their territory.¹⁵⁰

The Directives on: the assessment and management of flood risks, groundwater and pollution caused by *certain* hazardous substances discharged into the aquatic environment makes the EU water legislation whole, whose basis is the WFD, and with which they constitute a single entity. Later, in June 2008, the European Parliament and the Council adopted Marine Strategy Framework Directive¹⁵¹, (2008/56/EC). This Directive establishes a framework for the Member States to take the necessary measures for the purpose of accomplishing or maintaining a good environmental status¹⁵² in marine environment, not later than 2020.

4.1.3.2. International Conferences on Water Management

Specific guidelines and recommendations made at the global level, in truth, do not have a binding character, but they do have the force of instructions and internationally recognized rules of performing work, and as such they influence the water management in Bosnia and Herzegovina and the Federation of BiH.¹⁵³

One of the conferences that made an impact on the water management plans of almost all countries is the International Conference on Water and the Environment, held in Dublin, Ireland, in January 1992. The major deliverable of this Conference is a set of recommendations for implementing actions at the local, national and international level that are based on the following four principles of water management¹⁵⁴:

- *Fresh water is a finite and vulnerable resource, essential to sustain life, development, and the environment.* Since water sustains life, effective management of water resources demands a holistic approach, linking social and economic development with protection of natural ecosystems. The effective management links agricultural land and water uses across the whole of a catchment area or groundwater aquifer.
- *Water development and management should be based on a participatory approach, involving users, planners, and policy makers at all levels.* The participatory approach involves raising awareness of the importance of water among policy-makers and the general public. It means that decisions are taken at the lowest appropriate level, with full public consultation and involvement of users in the planning and implementation of water projects.
- *Women play a central part in the provision, management and safeguarding of water.* This pivotal role of women as providers and users of water and guardians of the living environment has

¹⁵⁰ Article 3.1-2 Water Framework Directive, Article 3.1-2

¹⁵¹ "Marine Strategy Framework Directive", (2008/56/EC), 17 June 2008

¹⁵² According to the Directive: 'Good Environmental Status' means the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations.

¹⁵³

▪ UN Conference on the Human Environment, Stockholm, 1972;
▪ UN Conference on Water, Mar de Plata, 1977;
▪ Conference on Environment and Development, Rio de Janeiro, 1992;
▪ World Summit on Sustainable Development, Johannesburg, 2002
¹⁵⁴ „The Dublin Statement on Water and Sustainable development“, Dublin, Ireland, 31 January 1992

seldom been reflected in institutional arrangements for the development and management of water resources. Acceptance and implementation of this principle requires positive policies to address women's specific needs and to equip and empower women to participate at all levels in water resources programmes, including decision-making and implementation, in ways defined by them.

- *Water has an economic value in all its competing uses and should be recognised as an economic good.* Within this principle, it is vital to recognize, first, the basic right of all human beings to have access to clean water and sanitation at an affordable price. Past failure to recognize the economic value of water has led to wasteful and environmentally damaging uses of the resource. Managing water as an economic good is an important way of achieving efficient and equitable use, and of encouraging conservation and protection of water resources.

The above-listed four principles of water management (the Dublin Principles) are the basis of ***integrated water resources management*** concept, which has been through the conclusions made at this Conference, and for the whole time following these Conclusions, promoted as a basis for development of national water sectors. *Integrated Water Resources Management is a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.* An important aspect of the integrated water resources management is general social inclusion, which implies: (i) coordination of water sector activities with other sectors, while defining the development policies, at all decision-making levels; (ii) involvement of all stakeholders¹⁵⁵ in the decision making processes. This, certainly involves, general social efforts in the area of educating the public so that all stakeholders would have the necessary knowledge for their full involvement in the decision-making processes; (iii) understanding that development planning decisions, in any sector (food production, transportation strategies, energy sector development, urban centres development), must include the impacts on water sector, as well; (iv) decision-making processes, in managing a specific river basin district, should also be based on the data related to the status of economy, sociology, environmental features, etc.

It should be noted that an integrated water resources management involves *a new way of thinking*, and thus a new way of acting, which primarily offers conceptual framework guidelines, rather than concrete and precise instructions. On the other hand, introducing this method of water resources management, as such, does not necessarily imply establishment of any new institutions. What is required is the change in the usual way of acting and thinking so that a wider domain exceeding the boundaries of one's own area of interest is taken into consideration and to understand that the tasks and activities of water sector cannot be independent from the activities pursued by other sectors. In addition to the above stated, this water management method is promoting the segment of decentralization through a reinforced influence of the stakeholders, while extending the decision-making process to the lowest levels. This is a systematic process of sustainable development according to which the management and use of water resources is carried out in the context of social, economic and environmental objectives. In brief, this is a concept that is based on inter-dependability of numerous beneficiaries of the finite water resources (increase in abstracted water volumes for irrigation – increased level of pollution from agricultural land – decrease in available water suitable for irrigation and industrial purposes). There are many examples suggesting that

¹⁵⁵ „Stakeholders“ is an English term used in this document to mean „interested party“ (both legal and physical), in accordance with the conclusions made at the „Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters“, Aarhus, 1998. This term covers different ministries outside the water sector responsible for physical planning and development issues, commerce, health care, energy, ecology, transport, economy. It also covers the representatives of local communities, scientific institutions, sports associations, non-governmental organizations, groups of citizens, etc.

unregulated and uncontrolled approach to uni-sectoral use of water resources is damaging and unsustainable.

4.1.3.3. Millennium Development Goals (MDG)

The adoption of the Millennium Declaration in September 2000 by 189 Member States of the United Nations (UN) was an important moment for global cooperation in the 21st Century.¹⁵⁶ The Declaration outlined the crucial challenges that mankind faces at the threshold of a new millennium; articulated responses to these challenges; and established specific indicators to assess progress towards interrelated goals and tasks in development, governance, peace, security, and human rights. The Declaration sets out, as a global program, 8 interrelated development goals. Furthermore, the Declaration defines numerous tasks to achieve these goals by 2015. This is, therefore, a universal and global programme to secure the welfare of the world's population and protect and promote human rights, a programme around which all development actors should congregate and cooperate – the public and private sector, local communities, civil society, NGOs, etc. working at the global and national levels.

Water management can certainly largely contribute to the process of accomplishment of MDGs. Neither economic nor social development may be enabled without a secure access to water resources and it is evident that the accomplishment of the majority of MDGs depends on the way the water is managed. An integrated water resources management follows the path of the sustainable management, which is, actually, the path supporting the accomplishment of MDGs.¹⁵⁷ The activities of reaching the MDG targets provide an opportunity to reconsider and modify the current development paradigm according to which the national development and strategy of mitigating or eliminating poverty, empower the multiple role of the water management in the activities related to economic development and environmental protection.

The manners and areas in which the water sector can give its direct contribution for accomplishing MDGs are presented in each of the 8 MDGs:

- *MDG 1: Eradicate poverty and hunger:* water and water resources management are essential for economic development, and at the same time, they directly provide for better living conditions for the poor. Poor regions are particularly vulnerable to floods, droughts and other water-related natural disasters, which falls under the scope of work of water sector;
- *MDG 2: Achieve universal primary education:* for our country, and therefore for the Federation of BiH, as well, this goal is about primary education quality which is connected to the safe water supply and elimination of diseases related to contaminated drinking water (usually supplied from the local water supply system in rural areas);
- *MDG 3: Promote gender equality and empower women:* women are usually the primary users of water, both within the households and within production-related activities (such as agriculture). In addition, the application of the Dublin Principles empower women to soundly participate in decision-making processes;
- *MDG 4: Reduce child mortality:* general health condition of the youngest directly depends on the status of environment, where proper water supply and sanitation have the key role;

¹⁵⁶ The publications used: The Human Development/Millennium Development Goals Report for Bosnia and Herzegovina“, UNDP BiH, 2003 and „Handbook for Developing Integrated Water Resources Management and Water Efficiency Strategies“, Global Water Partnership, 2006.

¹⁵⁷ It should be noted that the integrated water resources management does not only support the achievement of MDG, but also the long-term economic development, reduction of poverty and environment protection. This method of water management is not simply an action plan created for the purpose of achieving certain goals, but also the way of thinking that emphasizes the cross-cutting sectoral development planning, which MDG implies.

- *MDG 5: Improve maternal health:* women are more exposed to the diseases caused by contaminated water within families. Therefore, taking measures to improve water supply positively influences maternal health;
- *MDG 6: Combat HIV/AIDS, malaria, and other diseases:* Proper water supply, as well as effective water resources management at local level may help decreasing the level of water-related diseases;
- *MDG 7: Ensure environmental sustainability:* Water has the key role in sustainable use of water resources. In many areas, the major environmental problems, be it environmental pollution, erosions or loss of biodiversity, are associated with waters. A direct contribution that the water sector may give for the accomplishment of this goal is establishing balance between the economic development and the environmental sustainability.
- *MDG 8: Develop a global partnership for development:* Water is a natural resource that knows no boundaries, and there are many areas where the cooperation in water use on sustainable basis is necessary. What many regions and countries also share is a general commitment to accomplishing MDGs, and given the fact that water is of key importance for accomplishing these goals, the cooperation in management of this resource is of enormous importance.

4.1.3.4. Relevant Agreements and Conventions

The affiliation of Bosnia and Herzegovina territory to the Danube river basin and the Adriatic Sea basin determines or will be soon determining the specific water management framework and the basic international cooperation stipulated in the conventions, agreements and memoranda:

- ***The Danube River Protection Convention (Danube Convention)***

By ratification of the Convention on Cooperation for the Protection and Sustainable Use of the River Danube¹⁵⁸, Bosnia and Herzegovina assumed the obligations defined in this Convention. The objectives and principles of the cooperation between the contracting parties of the Convention are as follows:¹⁵⁹

- The Contracting Parties shall strive at achieving the goal of sustainable and equitable water management, including the conservation, improvement and the rational use of surface water and groundwater in the catchment area as far as possible.
- The Contracting Parties shall cooperate on fundamental water management issues, and take all appropriate legal, administrative and technical measures to maintain or improve the current environmental and water quality conditions of the waters within the river Danube catchment area.
- The Contracting Parties understand the urgency of taking water pollution abatement measures and of rational water use, as well as the urgency of taking measures for sustainable use of water. This objective in particular is directed to ensure *the sustainable use* of water resources for municipal, industrial and agricultural purposes.
- The “polluter pays” principle and the “precautionary principle” constitute the basis for all measures aiming at the protection of the waters within the River Danube catchment area.
- Water management cooperation shall be oriented on *sustainable water management*, which means on the criteria of a stable, environmentally sound development which are at the same time directed to: (1) maintain the overall quality of life; (2) maintain continuing access to natural resources; (3) avoid lasting environmental damage and protect ecosystems, which means exercising preventive approach.

¹⁵⁸ Official Gazette of Bosnia and Herzegovina No. 1/05 dated 25 January 2005

¹⁵⁹ Quotation from Article 2 of the Convention

For the purpose of implementation of this Convention, the International Commission for the Protection of the Danube River (ICPDR) has been established and headquartered in Vienna.

▪ ***Convention on the Protection and Use of Trans-boundary Watercourses and International Lakes (Helsinki Convention)***

The Convention was signed in March 1992 in Helsinki and it reflects the need to define the measures for prevention, control and reduce discharges of hazardous substances into water environment at the international level. The Convention defines general international cooperation and the framework of activities for the protection of surface and groundwater by *preventing, controlling and reducing* any transboundary impact. The Contracting Parties are required to create and comply with *realistic, reasonable and environmentally defined* water management plans. The Convention defines water management *principles*: *precautionary principle*, for the purpose of avoiding the potential transboundary impact of the release of hazardous substances; *polluter pays* principle, by virtue of which the costs of pollution prevention, and the control and reduction measures shall be borne by the polluter; and the principle according to which water resources shall be managed so that the ability of future generations to meet their own needs shall not be compromised, i.e. the *sustainable water management* principle. The Contracting parties are subject to the rules of action summarized as follows: (1) The emission of pollutants is prevented, controlled and reduced at source; (2) The status of trans-boundary waters is monitored; (3) Information sharing; (4) Liability for the damages caused; (5) Informing public. This Convention has not been signed or ratified by Bosnia and Herzegovina yet.

▪ ***Framework Agreement on the Sava River basin***

The regional cooperation of the countries gravitating to the River Sava has been defined in the *Framework Agreement on the Sava River basin*,¹⁶⁰ under which the Parties agreed to: (i) establish an international regimen of navigation; (ii) establish sustainable water management; (iii) undertake measures to prevent or limit adverse water effects and (iv) establish mechanisms for creating efficient multilateral cooperation among countries of the Sava River sub-basin.

▪ ***Treaty on the establishment of water management relations with the Republic of Croatia***

The bilateral relations with the neighbouring Republic of Croatia in the area of water management have been defined in a special document on establishing relations in the water sector between these two countries, being of their common interest (*Treaty between the Government of the Republic of Croatia and the Government of Bosnia and Herzegovina on the establishment of water management relations*¹⁶¹). This Treaty has been signed on the basis of the Convention on the protection and use of transboundary watercourses and international lakes – Helsinki Convention.

▪ ***Convention for the Protection of the Mediterranean Sea Against Pollution (Barcelona Convention)***

The Convention for the Protection of the Mediterranean Sea against pollution, together with the Protocol for the Prevention of pollution by Dumping from Ships and Aircraft, was signed in 1976 and entered into force in 1978. The purpose of these two documents is to abate pollution in the

¹⁶⁰ Official Gazette of BiH No. 8/2003 – International Agreements

¹⁶¹ Official Gazette of RBiH, special edition – International Agreements, No. 6 dated 25 December 2006

region of Mediterranean. The Convention was signed by the representatives of 21 countries bordering the Mediterranean Sea,¹⁶² and the ratification decision was published in 1977.¹⁶³

The Convention stipulates exchange of the information among the signatory countries in the situations of pollution emergencies aiming to reduce or eliminate damage resulting therefrom. The purpose of this Convention is to support the principles of sustainable development in the Mediterranean region, as well as reduction and, if possible, prevention of pollution caused by discharges into the coastal waters. The Contracting parties pay special attention to the following types of pollution: (i) pollution caused by dumping from ships and aircraft; (ii) pollution from ships; (iii) pollution resulting from exploration and exploitation of the continental shelf and the seabed and its subsoil (iv) pollution from land-based sources. The main principles of action according to this convention are summarized as follows: (i) precaution and prevention; (ii) *polluter pays* and cleans; (iii) integral control of pollution through water resources management in the coastal regions; (iv) free access to the information on environmental status and (v) reporting on the levels of pollution in water, soil and air. As already mentioned, the former Yugoslavia signed and ratified the Barcelona Convention in 1977. The State of Bosnia and Herzegovina, by the Act of Succession (Official Gazette of R BiH, No. 15/95 and Official Gazette of R BiH No. 15/95) incorporated a range of international environment-related commitments in its legal system, among which the above-mentioned Barcelona Convention on 1 March 1992, as well as Protocol 2 (1 March 1992), Protocol 3 (1 March 1992), Protocol 5 (22 October 1994) and Protocol 6 (22 October 1994).

▪ ***International Convention for the Prevention of Pollution of the Sea by Oil***

Signed in London in 1954, and entered into force in 1958, this Convention was accepted by the former Yugoslavia in 1973¹⁶⁴. The State of Bosnia and Herzegovina ratified this Convention in 1994.¹⁶⁵

▪ ***International Convention for the Prevention of Pollution From Ships***

Signed in London in 1973, and entered into force in 1983. The former Yugoslavia ratified it in 1985¹⁶⁶ and the State of Bosnia and Herzegovina in 1994.¹⁶⁷

▪ ***Convention on Access to Information, Public Participation in decision-making and Access to Justice in Environmental Matters (Aarhus Convention)***¹⁶⁸

The Convention was signed in 1998 in Aarhus, Denmark, and it emerged from the need to improve the possibilities of access to information and public participation in decision making in the area of environmental protection in order to improve the quality and applicability of the decisions made, and to give the public the opportunity to express its views and opinions on specific projects. The ratification procedure of this Convention in Bosnia and Herzegovina was completed in September 2008.¹⁶⁹

¹⁶² Among them, the Former Yugoslavia, as well

¹⁶³ Official Gazette of SFRY (International Agreements) No. 12/77

¹⁶⁴ Official Gazette of SFRYMU 60/73 and 53/74

¹⁶⁵ Official Gazette of R BiH 13/94

¹⁶⁶ Official Gazette of SFRYMU 2/85

¹⁶⁷ Official Gazette of R BiH No. 13/94

¹⁶⁸ „Convention on access to information, public participation in decision making and access to justice in environment matters“, Aarhus, Denmark, 25 June 1998

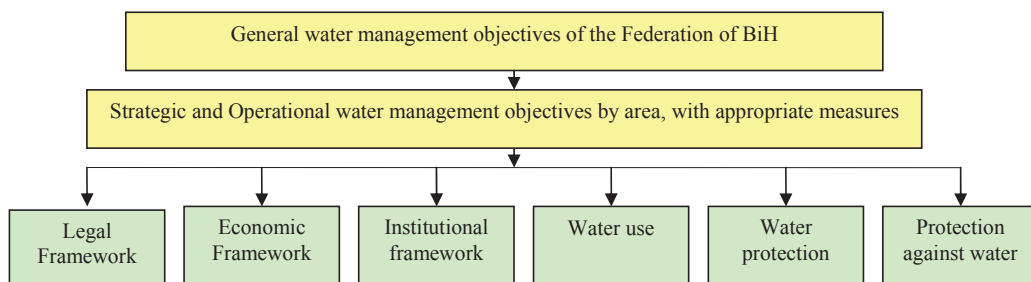
¹⁶⁹ Official Gazette of BiH No. 8/08 – International Agreements of 15 September 2008

4.2. General Water Management Objectives

The Law on Water of the Federation of BiH (LOW) recognizes the Water Management Strategy as the basic planning document for the water management development that includes the component of *goals and objectives of water protection, protection against detrimental effects of water and sustainable use of water*. The Strategy, according to the LOW, should determine the water management policy of the Federation of BiH, i.e. it should determine the course of action in terms of water protection, protection against detrimental effects of water and sustainable use of water.

Based on the presented situation in the area of water management in the Federation of BiH and the defined starting points, the *water management objectives* have been identified and described for the specified planning period until 2020, along with the appropriate *measures* that are to be implemented for the purpose of achieving these objectives.

Setting, defining and clarifying of the Strategy objectives have the following hierarchical arrangement:



The general water management objectives may be referred to as a development vision, representing a group of objectives stipulated in the Law on Water of the Federation of BiH, (Article 22), which are as follows:

- Achieving good status, i.e. good environmental potential of surface water and groundwater, i.e. water and water-related ecosystems¹⁷⁰;
- Reducing damage caused by various adverse effects of water;
- Ensuring the required quantities of water of appropriate quality for different purposes and encouraging sustainable use of water, taking into consideration the long-term protection of the available sources and their quality.

The above-mentioned objectives are related to the main water management areas of activity: protection of water, protection against water and use of water, while stimulating the *sustainable water management*, which was recognized as a public interest and which represents the determinant of development in this area.

¹⁷⁰ "Surface water status" means the status of a body of surface water determined by the poorer of its ecological status and its chemical status;

"Body of surface water" means a discrete and significant element of surface water such as a lake, a stream, river or canal, part of a stream, river or canal, a transitional water or a stretch of coastal water

"Ground water status" is the status of a body of ground water determined by the poorer of its quantitative or chemical status;

The term *sustainable water management*, not in the context of reaching such a management model, but as the basis for ideas and thoughts, involves the necessary change of focus of interest and action within the water management sector. In the previous period, this area was focused on ensuring the required quantities of water for supplying water to the population, food production and for satisfying the needs of energy sector and industry. The recognition of the environmental requirements has rarely been considered. Often, these two aspects of water demand have been presented as conflicting each other or representing an either/or choice: to satisfy either the population or the environment. The conclusions adopted at the Conference on Environment and Development¹⁷¹ held in Rio in 1992, made a shift in thinking about modern water management. The core principle is pointing to the inter-dependability of the population's life and environment. In other words, ensuring water for survival of the environment means indirect use of water to satisfy the needs of population. Water management should be organized so that the water quantity, quality and reliability are based on preservation of environmental functions on which the population depends, and that are to be preserved so that the use of water does not compromise the sustainability of aquatic and associated ecosystems.

¹⁷¹ United Nations Conference on Environment and Development (UNCED), Rio, 1992

4.3. Water Management Objectives and Measures to be taken by Area

4.3.1. Introduction

The hierarchical arrangement of the objectives, presented in section 4.2., primarily involves defining the strategic objectives determining the general course of action by area of water management. This is followed by operational objectives with implementation measures representing the „steps" along the courses of action toward the strategic objectives. The table below outlines the water management objectives, by area:

No.	Legal Framework
	Strategic objectives
1	Legal reform of the water sector, arising from the need to adapt to new social circumstances, along with the EU alignment in the water management sector as a part of process of BiH stabilization and association to EU
	Operational objectives:
1	Objectives arising from EU requirements
2	Objectives arising from the need to reform the national water law and institutions
	Economic Framework
	Strategic objectives
2	Adequate integration of water management sector in economic system as a whole, with larger representation of the economic tools in the process of water resources management
3	Improving efficiency, transparency and accountability in water management
4	Provision of financial viability in water management and reform of water pricing system along with progressive introduction of economic water price
	Operational objectives:
3	Economically more rational and environmentally more friendly management in water sector and implementation of measures for transition from the existing supply-side water management to the demand-side water management practice
4	Progressive transition to the system that would ensure long-term sustainable funding in the area of water management and full recovery of costs by customers or other sources
5	Improvement of the decision-making process regarding the forms of water resources use
	Institutional Framework
	Strategic objectives
5	Efficient institutional organization and administration capable of implementing the accession process and implementation of EU requirements in the water sector.
	Operational objectives:
6	Institutional strengthening of the water sector in the Federation of BiH
7	Capacity building
8	Intensification of cooperation with other sectors associated with water
9	Establishment of reference and authorized laboratory(-ies) for water quality testing
10	Improvement of alert system and efficient responding in cases of accidental water pollutions and water pollution emergencies
	Water Use
	Strategic objectives
6	Increase in coverage and improvement of public water supply systems
7	Ensuring conditions for sustainable use of water in the areas whose development depends on market interest

	Operational objectives:
11	Increase in coverage by public water supply systems from the current 60% to approximately 80% by the end of the Strategy planning period
12	Reduction of loss in public water supply systems by approximately 15%
13	Rational use, protection, improvement of the status and preservation of water resources being used or intended to be used for public water supply
14	Preservation of water resources in accordance with the terms and conditions of use and protection stipulated in the Law on Water of FBiH, in line with the expected water demand in the areas whose development depends on the market interest and overall economic progress
	Protection of Water
	Strategic objectives
8	Achieving and maintaining good status of surface water and groundwater for the purpose of protection of aquatic flora and fauna and needs of water users
	Operational objectives:
15	Development of Water Management Plan for the Sava River Basin District and the Adriatic River Basin District
16	Reduction of pollution from urban/sanitary waste waters
17	Reduction of emission of hazardous and toxic substances produced by individual industrial polluters through establishment of the emission limit values system, and "polluter pays" principle
18	Reduction in levels of pollution that reaches surface water and groundwater from regulated and "unregulated" solid waste landfills
19	Reduction of pollution from agricultural activities
20	Reduction of pollution from activities related to forest management
21	development of system for collecting, draining and treatment of waste water for settlements of less than 2,000 inhabitants
22	Reduction of pollution from traffic
23	Establishment of protected areas in accordance with the Law on Water of FBiH
	Protection against Water
	Strategic objectives
9	Reducing the risk at extreme hydrological phenomena
	Operational objectives:
24	Reconstruction and rehabilitation of existing, and construction and maintenance of protection facilities for the purpose of increasing the safety level in terms of flood control
25	Deployment and adoption of Plans for protection against adverse effects of water
26	Reduction of erosions
27	Setting out Programmes to combat droughts
28	Prevention and preparedness in case of disaster, such as dam demolition or overflow

4.3.2. Legal Framework

4.3.2.1. Methodological Approach

To be able to create a logical and consistent concept, set deadlines and define appropriate measures for meeting such deadlines under this concept in terms of legal and institutional aspects of water management in the Federation of BiH, this chapter provides clarifications and reasons for which specific approaches have been chosen.

4.3.2.1.1. Reasons for Review of Water Law and Legislation

In essence, there are two major reasons for pursuing a thorough review of water law and legislation in the Federation of Bosnia and Herzegovina. Namely, the dissolution of SFRY and the emergence of new states in the region created the need to define all relations in the society regarding water in a new way and under these new circumstances; to adequately determine the role of the state in water management sector and the role of all public administration authorities that are tasked to protect the public interest in this field, ensure the safety of the population in all aspects associated with water and to ensure an equal treatment of all businesses that require water in any respect for performing their manufacturing and service activities. This role of a contemporary State, which always depends on the constitutional structure of the country, is very different from the role that the socialist State had earlier in the circumstances of a all-embracing regime of social or state property.

These reasons are not exclusively specific for the Federation of BiH and Bosnia and Herzegovina, but one could say the same for all the countries in transition from a socialist to a market economy and democratically arranged society. This is a process which is, in various stages, underway in all Southeast European countries, except Greece.

Transforming the earlier social i.e. state system of water management into a modern system of water management is not a simple process, nor can it be completed in a short period of time by taking one-time “transitional” measures. This has been proven by the contemporary experience, not only in the neighbouring countries, but also in other countries of the Central and Eastern Europe. From a broader point of view, actually, on the entire European continent, a huge effort is being made to transform the traditional water management systems in different countries in order to ensure a better response to the challenges arising from the higher water demand, larger risk of further water pollution and endangering aquatic and dependent terrestrial ecosystems caused by the social development and, at the same time, the necessity of efficient response to the consequences of climate changes, which often occur in the form of floods or prolonged droughts that have really been reported in the past.

In addition to these reasons for changes in the water management system which are likely to be inherent to the transition process itself, in which the country is currently, and the needs caused by the changes in the nature, the BiH decision to join the European integration processes, particularly by signing the Stabilization and Association Agreement with the European Union (16 June 2008) and the ratification thereof (22 October 2008), also entails very specific and precise requirements with respect to how water should be managed in Bosnia and Herzegovina. As a part of the overall EU policy, meaning the policy that sets specific requirements for changes in all segments of the countries that wish to become candidates for EU membership, and then at certain point – EU members, the water management system in the Federation of BiH is facing numerous and complex requirements in this area. In short, this is a requirement for BiH to fully accept and apply the EU

legislation related to water and environment protection (as a direct broader water management framework), i.e. the section of the *Community Acquis* which regulates these issues in the EU.

4.3.2.1.2. Reasons for Institutional Reform

The structural changes in the society and the State that occurred during 1990s of the last century are the reason that the institutions responsible for water management, as well as numerous water regulations largely proved inadequate or completely unadjusted to the new situation. The 2006 Law on Water initiated the process of institutional change in water management. This ensured the basic prerequisites for further development of the institutional water management system that will be able to adequately respond to the challenges of water management in the Federation of BiH and Bosnia and Herzegovina and to ensure implementation of objectives set out in this Strategy.

4.3.2.1.3. Some General Characteristics of the Strategy and the Point in Time at which it is to be adopted with Respect to the Objectives and Deadlines

Pursuant the 2006 Law on Water, the Water Management Strategy has been defined as an instrument which determines the water policy of the Federation of BiH. The contents, authorizations and procedures for drafting and adoption of this Strategy are also the elements prescribed by the Law. The Strategy is to be adopted for the period of 12 years and the plan was to have it adopted by 2009. Leaving aside the overview and the analysis of the legally prescribed elements of the contents of the Strategy, it is necessary to point out the fact that most of these elements are identical to the elements contained in the EU Water Framework Directive (WFD), especially the mandatory elements of the river basin management plans. As the Water Framework Directive is an instrument of policy and as it must be transposed into the national legal systems of the Member States, the only way to transpose it to the legal system of the Federation of BiH is through binding regulations (i.e. laws and by-laws for enforcement of the laws). In the case of the Federation of BiH, the transposition of the Framework Directive, according to the assessment of the Ministry of Agriculture, Forestry and Water Management of FBiH has been already performed to a large extent in the 2006 Law on Water of FBiH. However, an evaluation of the actual level and quality of the *Community Acquis* transposition will be necessary during and within the implementation of SAA, in which matter it would be necessary to adopt a large number of by-laws beforehand.

At this point, the question is what approach to take in determining the scope and the contents of the Strategy. The Strategy certainly will not serve its purpose if it simply reproduces the commitments stipulated in the 2006 Law on Water. It must provide more than that, i.e. it must create a clear perspective for the legal framework at the time for development of a consistent water legislation system that would be in full compliance with the EU requirements.

Bearing in mind the above-mentioned reasons for which a thorough structural change of the water management system in the Federation of BiH, as well as at the BiH level is unavoidable, it seems logical that the Water Management Strategy, as an instrument of the long-term policy of the Federation of BiH, is required to, on one hand, be created primarily in the way that it contains general strategic objectives and to set out the course of institutional and legal changes in the water management sector caused by the internal reasons of the Federation of BiH and BiH, and then to set more specific operational objectives.

On the other hand, the Strategy must clearly define long-term and medium-term objectives that have to be achieved in order to incorporate all the water management-related EU requirements in the water management system of the Federation of BiH and BiH in accordance with the Stabilization and Association Agreement (SAA). More precisely, this segment of Strategy is

focused on the full transposition of EU water regulations, mostly through by-laws whose adoption deadlines are stipulated in the 2006 Law on Water. The Strategy, to some extent, stipulates a more flexible time frame than the one stipulated in the Law, because the Stabilization and Association Agreement sets out a six-year deadline for full transposition of the appropriate EU water regulations and their implementation in BiH. In addition, the Strategy sets out a precise timing for execution of the duties that the Federation of BiH must fulfil in accordance with the specific deadlines set out in SAA. The most important objective of the water management in the Federation of BiH and Bosnia and Herzegovina is achieving full compliance of the national water (management) legislation with the *Community Acquis* and its full implementation and ensured enforcement.

Both of these aspects, which are clearly visible and sufficiently defined at the time of preparing the Strategy, must be harmoniously and consistently developed within the Strategy because it is the only way to make it a purpose-serving and enforceable instrument on which the Federation of BiH will rely when making all legal and institutional interventions in the water management system, pending on the path towards EU in the years of implementation of the Strategy.

In addition to the above stated, it must be taken into account that the vital elements of the Strategy (especially its scope, structure, time schedule and timing of the changes), will be crucially affected by the content of the SAA Implementation Programme and the deadlines to be specified in the upcoming negotiations between BiH and the Commission of the European Communities¹⁷² regarding the incorporation and implementation of the EU water legislation in the BiH legal system, besides the commitments stipulated in the Stabilization and Association Agreement. It is therefore clear that the Strategy must be sufficiently flexible to allow compliance with the terms and conditions that are to be agreed on with the Commission and that it should not be a bottleneck or an obstacle in the process of association of BiH into the European Union, and particularly, that it should not be a political platform for adopting such legal and institutional arrangements that would, essentially, provide for avoidance or obstruction of the EU requirements in this area.

In summary, it can be stated that the Strategy, when it comes to legal and institutional water management framework, strives to accomplish the following strategic objective:

Strategic Objective 1:	Legal reform of the water sector, arising from the need to adapt to new social circumstances, along with the EU alignment in the water management sector as a part of process of BiH stabilization and association to EU
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4.3.2.2. Strategic Objective 1: Legal reform of the water sector, arising from the need to adapt to new social circumstances, along with the EU alignment in the water management sector as a part of process of BiH stabilization and association to EU

4.3.2.2.1. Objectives Arising from EU Requirements

The objectives that should be achieved and the purpose for which the water-related regulations are adopted in the EU are numerous, but one would not be mistaken to summarize it as *achieving a high level of environmental protection, as a whole, and the protection of human health*. The Water Framework Directive (WFD), which is the main legal and fundamental instrument of water policy in the EU, (and which is related to inland surface waters, transitional waters, coastal waters and groundwater), summarizes the objectives provided in a more complex form and these objectives include prevention of further deterioration and protection and enhancement of the status of water bodies, preservation and protection of aquatic ecosystems and terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems, promotion of sustainable water use based on a long-

¹⁷² Hereinafter referred to as the Commission

term protection of available water resources, enhancement of protection and improvement of the aquatic environment, *inter alia*, through specific measures for the progressive reduction of discharges, emissions and losses of priority substances and the cessation or phasing-out of discharges, emissions and losses of the priority hazardous substances for the purpose of progressive reduction of pollution of groundwater. One of the objectives is also to mitigate the effects of floods and lack of waters.¹⁷³

The Water Framework Directive is not the only legal instrument that must be transposed to the legal system of the Federation of BiH with regards to waters. During the work on the Strategy, an attempt was made to develop the comprehensive list of EU regulations that are directly related to the water sector and so-called “horizontal” regulations whose implementation is unavoidable in the water management process. (This list is provided in Section 4.3.2.4 - Appendices). It needs to be said that each of these pieces of legislation separately sets out the objectives (which for the purpose of this Strategy, may be referred to as “operational objectives”) that should be achieved upon the adoption of such pieces of legislation. At the same time, the EU water regulations contain the incorporated time schedule with specific deadlines for achieving the objectives set. By transposing the EU water regulations at the level of the Federation of BiH, the objectives will be established; the deadlines set and the measures that are to be taken for the purpose of achieving such objectives defined. Thus, the EU water management policy will become the FBiH water management policy as well, and since the obligation of transposition, implementation and enforcement of the regulations applies to the entire country, the same policy will be applicable to Republika Srpska (RS) and to Brčko District (BD) as well.

4.3.2.2.2. EU Requirements-based Principles

The principles and concepts of water management stipulated in the Water Framework Directive being generally agreed on in the professional and scientific circles have become a binding regulatory instrument. Accordingly, it is stated that the sustainable approach to managing an essential resource such as water does not only affect water as a valuable ecosystem; it also recognizes the economy and human health depending on this resource.¹⁷⁴

The holistic ecosystem protection ensures that the fresh and coastal (sea) water environment is protected in its entirety, meaning all rivers, lakes, estuaries, coastal and groundwater. The application of the concept identifying ambitious objectives and facilitating the utilization of flexible tools for their accomplishment is expected to ensure the human needs satisfaction, ecosystem functioning and biodiversity protection through achieving „good status“ of waters by 2015. These objectives are considered to be ambitious, concrete and comparable. At the same time, the Directive provides flexibility in achieving them in the most cost-effective way and introduces a possibility for priority setting in the planning.¹⁷⁵

The planning integration principle implies that the planning process that should lead to the establishment of a river basin (district) management plan needs to be coordinated in order to achieve the objectives set out in WFD. Whilst the WFD mainly describes water quality aspects for surface waters, it is a mandatory prerequisite to integrate also the water quantity planning aspects in these plans, mainly in terms of flood risk and drought management. The groundwater quantity aspects are already part of the WFD. At the same time, sectoral integration is essential, in particular

¹⁷³ Article 1, Water Framework Directive

¹⁷⁴ COMMISSION STAFF WORKING DOCUMENT, Accompanying document to the COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL „Towards Sustainable Water Management in the European Union“, First stage in implementation of the Water Framework Directive 2000-60-EC, Brussels, 22.03.2007, SEC(2007) 362, pp. 5-6.

¹⁷⁵ *Id.*

with the plans and programmes in the field of agriculture, rural and regional development, land use, navigation, hydropower and research.¹⁷⁶

The correct geographical scale principle implies that the natural area for water management is the catchment area or river basin. Since the catchment area cuts across administrative boundaries, water management requires close cooperation between all administrations and institutions involved. The Directive makes this cooperation mandatory within and between the EU Member States and encourages it with the countries outside the EU. It is considered that this principle, together with the above-mentioned planning integration principle, ensures true horizontal and vertical integration of the water management system.¹⁷⁷

The introduction of the “polluter pays” principle in the form of water pricing policy, with the element of cost recovery and the cost-effectiveness provisions are the milestones for the application of economic tools for the benefit of the environment. This will contribute to the sustainable management of scarce resources.¹⁷⁸

Active participation in the decision-making processes related to water management is the principle that became mandatory pursuant to Aarhus Convention and that is anticipated by the Framework Directive. The right to participate in the decision making related to the river basin is granted to all stakeholders, including businesses, farmers, environment non-governmental organizations and local communities.¹⁷⁹

4.3.2.2.3. Deadlines for Meeting EU Requirements

The Stabilization and Association Agreement (SAA) stipulates that the BiH accession to the European Union will be implemented progressively and that it will be fully accomplished in the transitional period of up to six years. The implementation of the SAA will be assessed on annual basis, and not later than the expiry of the third year from the SAA entering into force, a detailed assessment of its implementation in BiH will be made.¹⁸⁰ The deadline for progressive harmonization of the BiH legislation with the *Community Acquis* have started running as of 16 June 2008, when the SAA was signed and it expires on 15 June 2014, at latest (because this is the longest possible transitional period under the SAA).¹⁸¹ Within this six-year period, the long-term and the medium-term priorities have been established. The short-term priorities must be accomplished within a 1- to 2-year period, while the deadline for accomplishment of the medium-term priorities is 3 to 4 years. It is explicitly stated that the priorities concern both the regulations and their implementation.¹⁸²

Among the short-term priorities related to water management, the following can be pointed out: strengthening administrative capacity in preparation for implementing the Stabilisation and Association Agreement (SAA) and Interim Agreement (IA) commitments, accelerating the privatisation process, adopting a State environmental law to create the framework for nationwide harmonised environmental protection, establishing and ensuring proper functioning of the State Environment Agency, further strengthening the administrative capacity of the environment-related

¹⁷⁶ *Id.*

¹⁷⁷ *Id.*

¹⁷⁸ *Id.*

¹⁷⁹ *Id.*

¹⁸⁰ Article 8

¹⁸¹ Article 170

¹⁸² Council Decision on the principles, priorities and conditions contained in the European Partnership with Bosnia and Herzegovina and repealing Decision 2006/55/EC, Brussels, 6 November 2007, COM(2007) 657, Annex: the European Partnership with Bosnia and Herzegovina in 2007, pp. 5

institutions, in particular at State level, and improving communication and coordination between those institutions.¹⁸³

The following medium-term priorities are listed: continue work on progressive transposition of the Acquis, with particular emphasis on, *inter alia*, water quality management and integrated pollution prevention and control, increase investments in environmental infrastructure, with particular emphasis on waste water collection and treatment and drinking water supply, ensure integration of environmental protection requirements, in this case - water protection into definition and implementation of other sectoral policies.¹⁸⁴

The transposition and the subsequent implementation of the EU water regulations into the legal system of the Federation of BiH (within the upcoming six-year period) creates an obligation to meet the deadlines for achieving the objectives stipulated in these regulations. In terms of the deadlines for achieving the objectives that are, for instance, set out in the Water Framework Directive, these deadlines start running from the Directive's effective date (which is the basic term for calculating all deadlines¹⁸⁵), leaving the period of:

- Three years for its transposition into national legal systems and determining river basins, river basin districts and authorities competent for the river basin districts;
- Four years (or one year as of the expiry of deadline for the transposition) for characterization of the river basins: pressures, influences and economic analysis;
- Six years (or three years as of the expiry of deadline for the transposition) for establishing a monitoring network and (at latest) for commencing the consultations with the public;
- Eight years (or five years as of the expiry of deadline for the transposition) for public presentation of the draft river basin/river basin district management plan;
- Nine years (or six years as of the expiry of deadline for the transposition) for the final development of the river basin management plan, including the programmes of measures;
- 10 years (or seven years as of the expiry of deadline for the transposition) for introducing pricing policies;
- 12 years (or nine years as of the expiry of deadline for the transposition). The programmes of measures shall have been fully applied (operational);
- 15 years (or 12 years as of the expiry of deadline for the transposition) - the objectives related to the environment have been accomplished; the first managerial cycle has been completed;
- 21 years (or 18 years as of the expiry of deadline for the transposition) – the second managerial cycle to be completed;
- 27 years (or 24 as of the expiry of deadline for the transposition) the third managerial cycle to be completed.

When determining the deadlines for implementation of specific objectives of the Federation of BiH, the pattern set out in each Directive will have to be followed. It will be possible to agree on the necessary adjustments to the specific situation in the Federation of BiH and BiH within the process of implementation of SAA during the negotiations with the Commission of the European Communities.

This document provides an overview of the time frame for the Framework Directive. The analysis of the objectives and the deadlines for their implementation, that are set out in the other directives

¹⁸³ See above, ref. 6, pp. 6 and 11

¹⁸⁴ Repeated citation, pp. 17-18

¹⁸⁵ The other basic term can be the time of full transposition of the Water Framework Directive into the national legal system or the expiry of the deadline by which the transposition shall have been completed according to the Framework Directive.

that must be transposed into the legal system of the Federation of BiH can provide a relatively accurate time frame which would cover all commitments arising from the alignment of the water management sector of Federation of BiH with the EU requirements.¹⁸⁶

4.3.2.2.4. Instruments of International Water Law

In addition to the commitments arising from the Stabilization and Association Agreement, Bosnia and Herzegovina also has other international commitments arising from the international agreements to which BiH is one of the parties. The Strategy includes specific objectives and, accordingly, the obligations of the competent authorities arising from the implementation of the multilateral agreements on water management in the Sava River Basin (FASRB) and the Danube River Basin (DRPC) are also in compliance with the EU water policy. These objectives set out in the Strategy will be implemented in accordance with the appropriate instruments of the international commissions for river basins (ICSRB and ICPDR).

The BiH commitments under the agreement on the Adriatic Sea Coastal waters management are also presented in the form of objectives and timing for their accomplishment through application of the EU Marine Strategy, as well as the BiH commitments under other international agreements that BiH has ratified, such as the environmental protection agreements related to waters.

One should bear in mind the fact that, over time, the international commitments of BiH will be inevitably expanding. A part of the reason for this will be new international legal instruments that BiH will sign. However, another reason could be the fact that EU is a party to some multilateral agreement and that such an agreement, being a part of *Community Acquis*, also has to be transposed into the legal system and implemented.

4.3.2.3. Operational Objectives and Measures for Legal Framework

The operational objectives for the legal scope of actions are as follows:

Operational Objective 1:	Objectives arising from EU requirements
Operational Objective 2:	Objectives arising from the need to reform the national water law and institutions

4.3.2.3.1. Operational objective 1: Objectives arising from the EU requirements

4.3.2.3.1.1. Treatment of Municipal Waters and Industrial Waste Waters

The Council Directive of 21 May 1991 concerning urban waste water treatment (91/271/EEC) stipulates the objective which is to protect the environment from the adverse effects of the discharges of urban waste water and waste water from certain industrial sectors.¹⁸⁷ The deadline for transposition of this Directive into national systems of the Member States was 30 June 1993. The six-month deadline, i.e. by 31 December 1993, was given to the Member States to identify sensitive and less sensitive areas on their respective territories.¹⁸⁸

¹⁸⁶ This tabulation is given in Section 5 - Plan for implementation of measures for fulfilling water management objectives

¹⁸⁷ The term „urban waste water“ means domestic waste water or the mixture of domestic waste water with industrial waste water and/or run-off rain water. The term „industrial waste waters“ means any waste water which is discharged from premises used for carrying on any trade or industry, other than domestic waste water and run-off rain water.— Article 1 and 2

¹⁸⁸ Articles 5.1 and 6.1, Annex II.

The period of seven and a half years (i.e. by 31 December 2000) was given for the mandatory secondary treatment of waste waters before their discharge into a recipient for all discharges from agglomerations of more than 15 000 p.e. and additional five years (i.e. by 31 December 2005) for all discharges from agglomerations of between 10 000 and 15 000 p.e.¹⁸⁹ However, for waste water being discharged into sensitive areas, the deadline for higher degree of treatment than the secondary one for all discharges from agglomerations of more than 10.000 p.e. was shorter – only five and a half years, i.e. by 31 December 1998.

The Member States were given a six-month deadline as of the effective date of this Directive (i.e. by 31 December 1993) to adopt regulations stipulating the obligation to obtain a specific authorization or approval for discharging industrial waste waters into municipal collector systems and municipal water treatment plants. The deadline for phasing out the disposal of sludge to surface waters by dumping from ships or by discharge from pipelines or by other means was 31 December 1998.

It is well known fact that the implementation of the commitments under this Directive requires huge investment funds. Therefore, a good preparation of data and a realistic assessment of the deadlines for implementation of the commitments will be particularly important¹⁹⁰.

4.3.2.3.1.2. Protection of Groundwater

The objectives associated with the protection of groundwater against pollution and deterioration are stipulated in the provisions contained in several EU Directives.¹⁹¹ The Water Framework Directive stipulates the obligation of the European Parliament and the Council, acting on the proposal of the Commission, to adopt specific measures in order to prevent and control groundwater pollution aiming at achieving the objective of good groundwater chemical status. These measures are to be adopted within two years after the entry into force of the Water Framework Directive.¹⁹² These specific measures are focused on preventing deterioration of all groundwater bodies and in this matter, the measures include the criteria for the assessment of good groundwater chemical status and the criteria for the identification of significant and sustained upward trends and for the definition of starting points for trend reversals.¹⁹³

The deadline for transposition of the Directive 2006/118/EC into the national systems of the EU Member States was January 16, 2009, and the Member States were obliged to notify the Commission thereof. Regardless of this deadline, the Member States were to establish threshold values of pollutants in the groundwater and publish those threshold values in the river basin management plans by 22 December 2008.¹⁹⁴

¹⁸⁹ Article 4

¹⁹⁰ The findings contained in the National Action Plan (NAP) for the Mediterranean area in BiH related to reduction of the pollution caused by the terrestrial activities are the guidelines for the preparation of the information related to this matter for the entire territory of the Federation of BiH.

¹⁹¹ These are as follows:

- Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration;
- Directive 2000/60/EC ;
- Council Directive 80/68/EEC of 17 December 1979 on the protection of groundwater against pollution caused by certain dangerous substances.

Directive 2006/118/EC is considered „subsidiary directive“ of Water Framework Directive and it supplements and specifies certain issues set out in the Framework Directive.

¹⁹² Article 17, Paragraph 1

¹⁹³ Article 1, Directive 2006/118/EC

¹⁹⁴ Repeated citation, Article 3.5

The prevention of the pollution of groundwater by substances belonging to the families and groups of substances which if discharged into groundwater may endanger human health, water supply, harm the animate resources and aquatic ecosystem or obstruct other legal use of water is stipulated in the Directive of the Council 80/68/EEC of 17 December 1979 on protection of groundwater against pollution caused by certain dangerous substances. The Member States were obliged to transpose this Directive and notify the Commission thereof within two years.^{195/196} This Directive shall be terminated within 13 years after the entry into force of the Water Framework Directive.

4.3.2.3.1.3. Environmental Quality Standards Applicable to Water

The Directive of the European Parliament and of the Council on environmental quality standards related to water policy that is to amend the Directive 2000/60/EC (Water framework Directive) is currently in the procedure of adopting. The Directive, as proposed, includes only surface waters. The quality standards are established for 33 + 8 pollutants, classified as priority substances at the EU level and presented in the form of annual average of maximum emission limit values. Annex X of the Water Framework Directive shall be superseded in its entirety with a new text contained in Annex II of the Proposal of Directive.

The period proposed for the transposition of this Directive is 18 months as of the entry into force of this Directive. Certain number of old Directives shall be terminated on 22 December 2012 because the subject matter stipulated in these Directives has been updated and regulated in other regulations. The Member States have certain obligations related to the monitoring of pollution caused by priority substances and the reporting to the Commission by 22 December 2012.

The establishment of the Environmental Quality Objectives—EQOs and the Environmental Quality Standards—WQs for waters, in accordance with this Directive and several other Directives that are mentioned below is of special importance in view of development and application of the licenses for controlling the most serious pollutions of the environmental media (the focus in this matter is pollution of surface waters and groundwater) from industrial polluters. This is primarily related to creation of new legislative prerequisites for issuing licenses that would have an effect on *Integrated Pollution Prevention and Control—IPPC*. However, this could also be related to the development of other licenses that are based, for instance, on *General Binding Rules—GBRs* for discharge of pollutants into environment that are mainly applicable to *Small and Medium Enterprises—SMEs*.

The establishment of quality standards for water, i.e. for each water body, in accordance with the WFD requirements, at the same time allows for implementation of EU requirements that are related to the *Emission Limit Values—ELVs* of pollutants in waters, i.e. implementation of the *Best Available Techniques—BAT*, involving the application of the European approach for preventing and controlling the most serious environment pollutions through relying on the appropriate EU *Best Available Techniques reference Documents—BREFs*¹⁹⁷. The establishment of the Environmental Quality Objectives and the Environmental Quality Standards for waters, as well as the emission limit values will create prerequisites for application of a combined approach to protection of water against pollution. When applying the combine approach, however, it is necessary to clearly

¹⁹⁵ Article 21, Paragraph 1

¹⁹⁶ Interestingly, Greece was approved an additional period of two years (four years in total), subject to its accession on 1 January 1981.

¹⁹⁷ In accordance with Council Directive 96/61/EC of 24 September 1996 Concerning Integrated Pollution Prevention and Control; However, one should bear in mind that on 21 December 2007, the Commission confirmed the Proposal for a Directive of the European Parliament and of the Council on industrial emissions (integrated pollution prevention and control) (Recast); COM (2007) 844 final, Brussels, 21 December 2007.

delineate the competences of different public authorities. Namely, these issues, in any case must be under full competence of those authorities that are competent/responsible for ensuring appropriate status of water bodies in the Federation of BiH. This refers to the preparation, establishment and implementation of the quality objectives, quality standards and emission limit values applicable to waters. The exercise of these competences in practice is essentially the matter of cooperation between the authorities competent for issuing licenses for discharge of pollutants into the environmental media (IPPC and others) and the authorities competent for water management. The institutions competent for taking measures aiming at achieving and maintaining the prescribed status of water bodies must also be lawfully assigned the rights and obligations of proposing (or at least, providing recommendations that would be mandatory for adoption of the appropriate regulations) the quality objectives, quality standards and emission limit values, meaning that they would have a decisive influence on defining those sections of IPPC (and other) licenses in which the emission limit values of pollutants discharged into water recipients (water bodies) are established for each plant that is under obligation to obtain the IPPC license.

4.3.2.3.1.4. Water Intended for Human Consumption

The Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption sets out the objective to be accomplished by it. This objective is to protect human health from the adverse effects of any contamination of water intended for human consumption by ensuring that it is wholesome and clean. The Member States should transpose this Directive and notify the Commission thereof within two years.

4.3.2.3.1.5. Bathing Water Quality

The Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the management of bathing water quality and repealing Directive 76/160/EEC, lays down provisions for the monitoring and classification of bathing water quality; the management of bathing water quality; and the provision of information to the public on bathing water quality. This Directive supplements the Water Framework Directive. This Directive shall apply to any water body of surface water where the competent authority expects a large number of people to bathe and has not imposed a permanent bathing prohibition, or issued permanent advice against bathing. The Directive shall not apply to swimming pools and spa pools; confined water bodies subject to treatment or used for therapeutic purposes; artificially created confined waters separated from surface water and groundwater.

The Member States shall, *inter alia*, establish and maintain bathing water profiles, annually identify all bathing waters and define the length of the bathing season. They were under obligation to do so for the first time in 2008 before the start of the first bathing season that commences on 24 March. The bathing water quality assessment is carried out in relation to each bathing water after the end of each bathing season and on the basis of the set of bathing water quality data compiled in relation to that bathing season and the three preceding bathing seasons in accordance with the procedure set out in the Directive.

The classification and the identification of the quality status of bathing waters are carried out on the basis of the water quality assessments. The bathing water quality may be classified as *poor*, *sufficient*, *good* or *excellent*. By using adequate media and technologies, including the Internet, the Member States shall ensure that the information on bathing water quality is actively disseminated to the public. The structure of the information is laid down in the Directive, and the information must

be disseminated as soon as it is available and not later than the start of the fifth bathing season after 24 March 2008.

The deadline for transposition of this Directive into the national legal systems was 24 March 2008.

4.3.2.3.1.6. Protection of Water against Pollution Caused by Certain Dangerous Substances

The inland surface waters, internal coastal waters and territorial waters are subject to protection against intentional or accidental pollution caused by dangerous substances selected mainly on the basis of their toxicity, persistence and bioaccumulation, or substances which have a deleterious effect on the aquatic environment and which due to such characteristics represent a risk for human health, harm animate resources and aquatic ecosystem, impair natural beauty and imperil other legitimate use of water. The Directive 2006/11/EC of the European Parliament and of the Council of 15 February 2006 on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community¹⁹⁸ lays down the provision of adopting a programme whose implementation would be based on the environmental quality standards (*EQSs*) applicable to waters, and based on which the emission standards would be established, i.e. the emission limit values (*ELVs*).

The deadlines for implementation of the objectives set out in this Directive (including the deadlines identifiable by the programmes for applying quality standards and emission limit values) are associated with the deadlines for adopting the first river basin management plan (in the Federation of BiH, this refers to the river basin districts) and other deadlines set out in the Water Framework Directive. The Directive lays down the provision for informing the Commission of implementation of this Directive at intervals of three years, and for the first time for the period from 1993 to 1995.

4.3.2.3.1.7. Protection of Water Against Pollution Caused by Nitrates

The objective laid down in the Council Directive 91/676/EEC of 12 December 1991 concerning the protection of water against pollution caused by nitrates from agricultural sources is defined as “reducing water pollution caused or induced by nitrates from agricultural sources and preventing further such pollution“. The Directive applies to surface freshwater bodies and fresh groundwater bodies, estuaries, coastal waters and marine waters. The deadlines set out in this Directive start running after its entry into force, as a starting point, and these deadlines are set for carrying out the following commitments assumed by the EU Member States:

- Two years for transposition of this Directive into the national legal systems;
- Two years for designating all known areas of land in their territories which drain into the identified water recipients and which contribute to pollution, as vulnerable zones;
- Four years as of the designation of the vulnerable zones, i.e. six years after the entry into force of this Directive, and subsequently at least every four years, for reviewing and if necessary, revising the decisions on the designation of vulnerable zones, for the purpose of taking into account factors unforeseen at the time of the previous designation,
- Two years for establishing a code or codes of good agricultural practice, to be implemented by farmers on a voluntary basis;
- Two years for setting up and implementation of a programme for training and information for farmers, promoting the application of the code(s) of good agricultural practice;
- Two years from the initial designation of the vulnerable zones (i.e. four years after the entry into force of this Directive), i.e. one year after the subsequent designation or review of the

¹⁹⁸ Superseding Directive 76/464/EEC

vulnerable zones, for establishing action programmes with regard to designated vulnerable zones focused on reduction and prevention of further pollution caused by nitrates;

- Two years for implementation of the one-year programme of monitoring the nitrate concentration in freshwaters and repeating this monitoring programme at least every four years;
- Every four years, for reviewing the eutrophic state of the fresh surface waters, estuarial and coastal waters;
- Four years and at each following interval of four years, for submitting the Report to the Commission regarding the activities and the results of measures taken based on this Directive. This report is to be submitted within six months after the four-year period deadline.

4.3.2.3.1.8. Water Quality for Fish

The objective to be achieved by the Directive 2006/44/EC¹⁹⁹, which supersedes the Directive 78/659/EEC, is to protect or improve the quality of those running or standing fresh waters which support, or which, if pollution were reduced or eliminated, would become capable of supporting, fish belonging to indigenous species offering a natural diversity and the species the presence of which is judged desirable for water management purposes by the competent authorities. The Member States shall, under this Directive, divide waters into salmonid waters and cyprinid waters. Both water categories are designed with guide parameters and mandatory parameters that must be satisfied through the implementation of a programme to be adopted and implemented by the Member States within a five-year period as of designation of salmonid and cyprinid waters. It should be mentioned that this Directive does not apply to waters in natural or artificial fish ponds used for intensive fish-farming.

The Directive lays down the obligation to report on the implementation of this Directive to the Commission every three years, and the 1993-1995 period was identified as the first period for which the Member States were obliged to deliver such a report.

4.3.2.3.1.9. Water Quality for Shellfish

The Directive 2006/113/EC of the European Parliament and of the Council of 12 December 2006 on the quality required of shellfish waters lays down the quality standards in the form of guide and mandatory values and parameters. The objective is to protect and improve the quality of coastal and brackish waters designated by the Member States in order to support shellfish life and growth and thus to contribute to the high quality of shellfish products directly edible by man.

The Directive sets out the obligation of the Member States to establish programmes in order to reduce pollution of shellfish waters and ensure that designated waters conform to the established quality standards (i.e. values and parameters) within six years following the designation of such waters.

At intervals of three years, starting from 1993, the Member States shall send information to the Commission on the implementation of this Directive.

¹⁹⁹ Directive 2006/44/EC of the European Parliament and of the Council of 6 September 2006 on the quality of fresh waters needing protection or improvement in order to support fish life (codified version)

4.3.2.3.1.10. Rules for Extreme Event Scenarios

The issues related to the assessment and management of flood risks, where “flood” means the temporary covering by water of land not normally covered by water and it includes floods from rivers, mountain torrents, Mediterranean ephemeral water courses, and floods from the sea in coastal areas are regulated in the EU for the purpose of reducing potential adverse consequences of flooding for human health, the environment, cultural heritage and economic activity.²⁰⁰ The deadline for transposition of this Directive was 26 November 2009. Member States shall complete the preliminary flood risk assessment by 22 December 2011.²⁰¹ This preliminary flood risk assessment shall be reviewed, and if necessary updated, by 22 December 2018 and every six years thereafter. Member States shall ensure that the flood hazard maps and flood risk maps are completed by 22 December 2013.²⁰² The deadline for reviewing and updating of these maps is 22 December 2019. The deadline for Member States to complete and publish flood risk management plans for the river basin districts or other management unit is 22 December 2015,²⁰³ and the deadline for their reviewing and updating is 22 December 2021.

This arrangement of objectives and deadlines for their accomplishment allows for, as in the case of Water Framework Directive, relatively precise structuring of the appropriate objectives and deadlines in the Federation of BiH.

It should be taken into consideration that flood is only one phenomenon within a range of natural (elemental) adversities or in a broader sense, disasters or *hazard*²⁰⁴ and that flood risk management must be an integral part of the strategy of national platform for reduction and mitigation of disaster consequences. The efforts of the United Nations in this area are set out in the International Strategy for Disaster Reduction, such as Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters,²⁰⁵ will serve as a very good guide for pursuing the relevant activities in the Federation of BiH and engaging in the measures being implemented in this regard in the EU.

The Water Management Strategy also steers the policy of the Federation of BiH that is related to the water shortages and draughts. In addition to the legally prescribed conditions for declaring the situation of water shortage or drought and the measures to be taken during such a situation, including the restricting and denying the right to water, it is necessary to, in cooperation with the authorities responsible for the SAA implementation, as soon as possible provide for a possibility to engage the competent authorities and the institutions of the Federation of BiH in the activities related to monitoring of water shortages and droughts within the EU.

²⁰⁰ Article 1 of the Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks; This Directive is practically a supplement to the Water Framework Directive in terms of flood risks, because it sets out a close coordination with the Framework Directive, particularly in terms of the plans related to the assessment and management of flood risks that are to be synchronized and coordinated with the river basin management plans.

²⁰¹ Article 4.4

²⁰² Article 6.8

²⁰³ Article 7.5

²⁰⁴ The term „*Hazard*“ means a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydrometeorological and biological) or man-made (environmental degradation and technological hazards). - UN INTERNATIONAL STRATEGY FOR DISASTER REDUCTION (ISDR), str. 1.

²⁰⁵ Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters; World Conference on Disaster Reduction 18-22 January 2005, Kobe, Hyogo, Japan; ISDR—International Strategy for Disaster Management.

4.3.2.3.1.11. Information System

The Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) lays down general rules for establishing the information system, including metadata, spatial data sets and spatial data services; network services and technologies; agreements on sharing, access and use of data, coordination and monitoring mechanisms, processes and procedures, established, operated or made available in accordance with the Directive. The information infrastructure is established for the purposes of EU environmental policies or activities which may have an impact on the environment.

The deadline for transposition of this Directive into the national legal systems was 15 May 2009. Within the following year i.e. no later than 15 May 2010 Member States shall send to the Commission a report including summary descriptions of:

- how public sector providers and users of spatial data sets and services and intermediary bodies are coordinated, and of the relationship with the third parties and of the organisation of quality assurance;
- the contribution made by public authorities or third parties to the functioning and coordination of the infrastructure;
- information on the use of the infrastructure;
- data-sharing agreements between public authorities;
- the costs and benefits of implementing this Directive.

Every three years, and starting no later than 15 May 2013, Member States shall send to the Commission a report providing updated information in relation to this matter.

Taking into account these developments in the EU, the commitment of the Federation of BiH, as well as the endeavours to create the same commitment at the level of BiH, being subject to international law and having authorities through which the communication with the EU authorities is conducted, is that the information system being developed within the system of water management of the Federation of BiH should be entirely a part of the environmental information system and that its development must comply with the requirements and development based on the INSPIRE Directive and other EU regulations, in order to at certain point - which will be, undoubtedly, clearly specified during the negotiations with the Commission - easily connect it with all elements of infrastructure for spatial information in the European Union. In order to make this commitment effective, it will be necessary to as soon as possible (without waiting for the detailed assessment of the alignment of the regulations of the Federation of BiH with the EU regulations, in the third year of SA implementation) develop a quick assessment of the existing commitments, regulations and development statuses of the information system related to the waters in the Federation of BiH with respect to the relevant EU requirements and take appropriate measures in accordance with the results of such an assessment.

4.3.2.3.1.12. Joining EU Intercalibration Network

Annex V of the Water Framework Directive²⁰⁶, lays down the provision for Member States to establish biological monitoring systems for the purpose of estimating the values of the biological quality elements specified for each surface water category or for heavily modified and artificial

²⁰⁶ Article 1.4.1

bodies of surface water. The monitoring procedure for ensuring the compatibility of the results produced through the biological monitoring in Member States is also established. These results are, indeed, the central part of the classification of environmental status of waters. To facilitate the implementation of this commitment, i.e. to achieve the set objective, it has been necessary to provide for the possibility of comparing the monitoring results and the classification system through an intercalibration network consisting of sites for monitoring in each Member State and in each eco-region in the Community. This commitment implies that all Member States shall collect certain information related to the sites included in the intercalibration network to enable the assessment of compatibility of the national classification system with the normative definitions set out in Annex V of the Water Framework Directive and the compatibility of the classification systems among Member States.

The Commission Decision of 17 August 2005 on the establishment of a register of sites to form the intercalibration network in accordance with Directive 2000/60/EC of the European Parliament and of the Council (notified under document number C(2005) 3140) sets out the intercalibration network of sites in the EU countries. It is important to mention that according to this Decision, whose transposition into the national legal systems is not allowed, as explained above, enabled Norway, but also Bulgaria and Romania, which were not Member States at the time, to participate in the intercalibration network and include their biological monitoring sites in this network.

This opens a window of opportunity for BiH to include its sites in the intercalibration network of the European Union before becoming an EU Member State. It is in the interest of the Federation of BiH to make it happen as soon as possible. Accordingly, in cooperation with the authorities responsible for the SAA implementation, this possibility should be considered and the timeframe, the resources, the competences and obligations of the authorities should be determined for the purpose of carrying out the necessary preparations for joining the EU network and for performing subsequent obligations required after such joining on a regular basis.

4.3.2.3.2. Operational Objective 2: Objectives arising from the need to reform the national water legislation and institutions

The constitutional profile of Bosnia and Herzegovina requires, on one hand, a specific approach in the development of entity-level water regulations, in the sense that these regulations are to be adopted by both entities, without clearly defined obligation based the BiH constitutional system stipulating that these regulations must be harmonized (compliant/not conflicting/consistent).

On the other hand, clearly defined requirements in terms of human rights and the rights of BiH citizens to healthy environment, as well as the rights of business entities based on the BiH Constitution and supported by the constitutions of both entities require the numerous issues related to water legislation to be regulated in both entities in such a manner that they ensure identical position and equality of all BiH citizens. This means that (parallel) systems of water legislation existing in BiH (two entity-level and one district-level system) must be harmonized, in which matter, a harmonized implementation of these regulations must also be ensured.

Furthermore, the lack of a civil code of BiH (or the Federation) that would thoroughly regulate numerous relations with respect to water, and which have been regulated within the custom and/or civil law and statutory law for centuries, requires these relations (statutory relations, water servitude-related relations, certain prohibitions, etc.) to be specifically and carefully regulated by legal principles, while respecting the achieved level of development and inherited patterns of behaviour. In this context, special attention should be paid to the specific requirements of the

International Community, primarily the UN Economic and Social Council (ECOSOC), in connection with constituting the human right to water.

BiH signed the Stabilisation and Association Agreement with the European Union and the deadlines for its implementation have started running. This means that this Strategy, being the key document on water policy in the Federation of BiH, must fully include the process of transposition of a very extensive and in no way simple corpus of legal principles of *Community Acquis* that are related to water and the projected prerequisites for efficient implementation of such new water legislation. In addition, the process of accession to the European Union involves entering into numerous international agreements to which the European Union has become a party, and consequently each of these agreements has become an integral part of the *Community Acquis* and their transposition into the legal systems of the EU candidate countries and their practical application are an additional obligation.

The above statements point out to the great importance of developing a reliable mechanism of coordination in exercising competences of all public entities in BiH (within the Federation of BiH, between the Entities and the District, at the level of BiH and between BiH and the Entities and the District). For FBiH, this issue is particularly important because the Cantons, as well, have their own important competences in water management.

The existence of coherent, fully harmonized system of legal principles in the Entities and Brčko District, as well as the system of coordination in their further development and implementation, would ensure a proper basis for upgrading the water management system in BiH through adequate high-quality activities of BiH on the international scene. BiH, as a state, which is subject to international law and a country on the path towards the European union membership is expected to promptly and properly, in an adequate manner, respond to the obligations being set before it in connection with national water resources management. *To achieve this objective, a sound professional strengthening of the competent state authorities is necessary.* In the first place, this is about strengthening capacities of the Ministry of Foreign Trade and Economic Relations of BiH for successful exercising of the established capacities in terms of environmental protection and water resources management.

In this context, one should take into consideration the requirement for establishing a state-level environmental agency that would be used for establishing communication between the State of BiH and the EU competent authorities, being primarily the communication with the European Environmental Agency, other authorities of the International community, such as UNECE Secretariat or other institutions established on the basis of multilateral water agreements and environmental agreements to which BiH is a party, river basin commissions, such as ICPDR or Sava River Basin Commission, etc. Only the State of BiH can communicate with all these authorities, and not the Entities or the District. There are also other reasons for fulfilling this requirement to establish a national environmental agency of BiH; however, it seems that the above-mentioned reasons are the most important ones at this time, when the State is at the very beginning of its implementation of the Stabilization and Association Agreement (SAA) with the EU.

Without such an approach and prompt taking of the appropriate measures, it is difficult to expect that this Ministry would, in the near future, be capable of responding to the complex requirements that will be (according to the abundant experience of the other countries that became EU member States) set before BiH, as an EU candidate country, from the EU level.

The legal obligation for adopting this Strategy, being a part of the Environmental Strategy of the Federation of BiH, seems to support this approach. Such a commitment of the legislators does not mean that this legal principle should be taken *ad literam* and it should not be understood that the water management policy (strategy) is literally a part of the document or a chapter in the document on environmental policy (strategy) and that the intention of the legislators has been exclusively focused on having a separate section within the environmental policy document where all issues related to the water management policy in the Federation of BiH would be elaborated. On the contrary, this Strategy, as a policy document within a social sector that is probably one of the most complex ones, should be a separate document; however, in terms of its content and gist, it must be fully compliant, and under no circumstances in conflict with the principles and commitments set out in the environmental policy of the Federation of BiH and all of its elements. This Strategy and the environmental strategy document must constitute a unity.

A clear strategic commitment to this approach of water management would contribute to a faster development of the mechanism for high-quality interdepartmental coordination at the level of the Federation of BiH, particularly in terms of the environmental protection and the need for linking and harmonizing all of the water management activities being currently implemented with the activities related to the environmental protection. This commitment would open, on one hand, a possibility for a comprehensive strategic review of the allocation of competences over water management in the Federation of BiH. Namely, traditionally, this area of water management used to be linked to agricultural sector for a very long period of time, and the competence of authorities responsible for agriculture has been always coupled with an additional competence – water competence. The contemporary development, particularly in Europe, based on *inter alia* the standpoint that agriculture is one of the largest users, but also polluters of water, and that therefore, in these modern times, the necessary impartiality and integrated approach to water management within river basins cannot be ensured through the competence of this Department, indicates that the arrangements aiming at departmental unification of water management sector and the environmental and physical planning sector should be considered.

On the other hand, this commitment would contribute to a quicker abandonment of the water management methods inherited from the past (that were more focused on construction, utilization and maintenance of hydro-technical facilities and systems, rather than on water management) and it would contribute to the creation of a specific water management system adjusted to local needs and capabilities, which would be developed on the principles and trends generated by the European Union, primarily on the principle of integrated river basin management accompanied by the application of the ecosystem approach.

4.3.2.4. Measures for Achieving Strategic and Operational Objectives

For the purpose of achieving the objectives laid down in this Strategy within the deadlines set in the 2006 Law on Water, the SAA and this Strategy (in Annex II), the competent authorities of FBiH will be taking measures prescribed in the regulations of the Federation of BiH and international agreements to which BiH is a party, and particularly the measures prescribed in the SAA implementation plan and the decisions/conclusions adopted by the authorities competent for planning and implementing of SAA. These measures will include:

- Drafting and adopting water regulations in accordance with the established priorities within the deadlines set;

- Transparency in the regulation drafting process will be ensured in accordance with the relevant requirements set out in the multilateral conventions (Aarhus Convention, for instance) and EU requirements;
- Consultations on regulations, being in the preparation stage, with Cantons, the other Entity and Brčko District, other authorities and public organizations, with the public and stakeholders (particularly with professional organizations and NGOs), that would be carried out on a regular basis and within the deadlines compliant with EU requirements, and according to the previously prepared plan;
- Continuous monitoring of implementation and enforcement of the water regulations;
- Continuous research regarding all issues relevant for water management in BiH that will facilitate adopting decisions based on the objective findings of experts and scientists, particularly in the area of public-private partnership and establishment of water users associations;
- In the third year of SAA implementation, a review of all water regulations will be performed within a detailed SAA implementation;
- Based on the performed review of regulations, amendment to those regulations will be made within the deadlines set for SAA implementation;
- Strengthening capacities of the FBiH institutions competent for water management, development, implementation, consistent and full enforcement of the water regulations and involvement in all policy development processes, planning and implementing national and international obligations of BiH, both in terms of expertise and in terms of technical and budget matters.

4.3.2.5. Annexes:

4.3.2.5.1. Annex 1: List of EU documents related to water management

- Directive 2000/60/EC of the European Parliament and the Council establishing a framework for Community action on water policy (WFD Directive)
- Council Directive of 21 May 1991 concerning urban waste water treatment (91/271/EEC) amended by the Directive 98/15/EC - (UWWT Directive)
- Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources (Nitrate Directive)
- Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks
- Council Directive 80/68/EEC of 17 December on the protection of groundwater against pollution caused by certain dangerous substances
- Directive 2006/118/EC of the European Parliament and the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration
- Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption, which amended Directive 80/778/EEC (Drinking Water Directive)
- Council Directive of 16 June 1975 concerning quality of surface water intended for the abstraction of drinking water in the Member States (75/440/75) – (amended by the Council Directive of 9 October 1979 (79/869/EEC) i Council Directive of 23 December 1991 (91/692/EEC))
- Council Directive of 9 October 1979 concerning the methods of measurements and frequencies of sampling and analysis of surface water intended for the abstraction of drinking water in the Member States (79/869/EEC) – (amended by the Council Directive of 19 October 1981 (81/855/EEC), Council Directive 23 December 1991 (91/692/EEC), Council Regulation (EC) No. 807/2003 of 14 April 2003)

- Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the management of bathing water quality and repealing Directive 76/160/EEC (Bathing Water Directive)
- Directive 2006/11/EC of the European Parliament and of the Council of 15 February 2006 on pollution caused by certain dangerous substances discharged into aquatic environment of the Community (repeals Directive 76/464/EEC and partially 91/692/EEC i 2000/60/EC)
- Directive 2006/44/EC of the European Parliament and of the Council of 6 September 2006 on the quality of fresh waters needing protection or improvement in order to support fish life
- Directive 2006/113/EC of the European Parliament and of the Council of 12 December 2006 on the quality required of shellfish waters
- Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for Community action in the field of marine environmental policy (Marine Strategy Directive)
- Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information System in the European Community (INSPIRE)
- Commission Decision of 17 August 2005 on the establishment of a register of sites to form the intercalibration network in accordance with Directive 2000/60/EC of the European Parliament and of the Council (C(2005) 3140) (2005/646/EC)

4.3.2.5.2. Annex 2: List of EU Directives relevant for water management

- Council Directive 79/409/EEC of 2 April 1979 on the Conservation of Wild Birds
- Council Directive 92/43/EC of 21 May 1992 on the conservation of natural habitats and of the wild fauna and flora
- Council Directive 86/278/EEC of 12 June 1986 on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture
- Council Directive of 15 July 1991 concerning the placing of plant protection products on the market (91/414/EEC)
- Council Directive 96/82/EC of 9 December 1996 on the major-accidents involving dangerous substances (Seveso Directive)
- Directive 98/8/EC of the European Parliament and of the Council of 16 February 1998 concerning the placing of biocidal products on the market
- Council Directive 97/11/EC of 3 March 1997 amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment (EIA Directive)
- Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment (SEA Directive)
- Directive 96/61/EC of 24 September 1996 concerning Integrated Pollution Prevention and Control (IPPC Directive)
- Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EC
- Directive 2003/35/EC of the European Parliament and of the Council of 26 May 2003 providing for public participation in respect of the drawing up certain plans and programmes relating to the Environment and amending with regard to public participation and access to justice Council Directives 85/337/EEC and 96/62/EC

4.3.2.6. Legal Aspects of the Public-Private Partnership

During the period of validity of the 1998 Law on Waters of the Federation of Bosnia and Herzegovina, the Cantons adopted their first laws on water and other water regulations falling under their competence. In accordance with the 2006 Law on Water of the Federation of Bosnia and Herzegovina, the Cantons are obliged to harmonize the provisions of the Cantonal laws on water with the provisions of the LOW. This Law sets out the scope of authorizations assigned to the Cantons for regulating these issues within their respective regulations. Namely, the Cantonal laws regulate the issues of organization and performance of the activities falling under the Cantonal competence in accordance with the FBiH LOW. As no mechanism of coordination and, possibly, verification and information regarding the activities is not set out in the LoW in connection with this requirement to harmonize the Cantonal water regulations, it will be necessary to legally regulate this obligation, as well, for the purpose of ensuring more reliable and more efficient grounds for coordination in adopting water regulations and their enforcement.

In terms of the Cantonal legislation related to water, it would be necessary to emphasise the strategic importance of the commitment to divide the competences related to ensuring water intended for human consumption between the Federation of BiH and the Cantons in such a manner that FBiH is to adopt the regulations on the quality of water intended for human consumption and the regulations on effluents, while the development and legal regulation of the issues related to use and maintenance of the infrastructure for public drinking water supply and elimination of waste water should fall under the exclusive competence of the Cantons. The issue of public-private partnership in terms of the management of these infrastructure facilities is the issue that will become increasingly important in the upcoming period and must be given great attention at the level of the Federation of BiH in order to achieve the relevant policy objectives in the way that they ensure practically equal position of all citizens in the Federation of BiH, i.e. in coordination with the authorities of Republika Srpska– all citizens of BiH.

The adoption of the new water regulations, i.e. the by-laws compliant with the 2006 Law on Water that would make the water legal system of the Federation of BiH complete, which will, however, be to a large extent harmonized with EU regulations, will create the prerequisites for transition from the current water use licensing system to the water rights system of a different profile, which would be better adjusted to the nature of new social relations developing in BiH. In this sense, water concessions and other forms of contractual investment of private capital in the water management system and municipal water system will be the administrative and contractual forms that would trigger the public-private partnership development by the end of SAA implementation period. The possibilities of development and the anticipated range of public-private partnership in BiH have not been explored sufficiently to enable instigation of such privatization interventions immediately and in full scale. Therefore, it is necessary to conduct an additional systematic review of the entire water sector, as well as an assessment of the opportunities for this type of development, which the Federation of BiH undoubtedly needs.

In this context, the issue of water concessions is unavoidable. Harmonizing the competences and regulations associated with water concessions between the Federation of BiH and the Cantons is necessary in order to avoid negative consequences for the water resources and public infrastructure, which have been noticed in the past, especially when it comes to inter-sectoral issues, such as, for instance, the issue of hydro power plant construction. In any case, the inter-sectoral (interdepartmental) harmonization, in addition to the harmonization of the above-mentioned issues between the Federation of BiH and the Cantons, needs to be ensured through, *inter alia*, a consistent

and timely application of the instruments for environmental management, such as Environmental Impact Assessment and Strategic Impact Assessment. In addition to the authorities competent for water management, the authorities competent for environmental protection, both at the BiH Federation level and the Cantonal level, must also be given an opportunity to influence the decision-making in all water concession awarding procedures, i.e. they have to be given an opportunity to protect the interests of the resources for which they are competent by virtue of law.

The issues of drainage and irrigation should also be taken into consideration on the basis of the previously developed assessment of current situation and future needs in the Federation of BiH and in addition, the opportunities and needs for establishing Water Users Associations - WUAs for the purpose of pursuing these activities should be investigated (using the models that have been well-known in the European Countries for hundreds of years, but also the models that used to be applied in Bosnia and Herzegovina in the past). In connection with this aspect of water management, it will be necessary to develop an overall analysis of property-related legal issues that would enable an argument-based selection of the legal and institutional arrangements. Namely, the existing hydrotechnical facilities, whose purpose is drainage and irrigation, are still exclusively publicly owned (by State, Cantons, etc.). With the development of new social relations, the need for these facilities to be clearly separated from the state-owned property is more and more evident, as well as for them to be used, developed, maintained and operated by fully relying on the funds collected from the users in the form of charges for water services provided by those hydrotechnical facilities.

At the same time, the EU policy, expressed through water management principles and legal instruments that have been developed on these principles, through a very clear and explicit requirements imposed on the EU candidate countries, unequivocally requires full exclusion of the State and the state authorities/bodies from the managerial processes related to these hydrotechnical facilities. Namely, the river basin management also involves the management of these activities, and in this matter the central state authorities can have only supervisory/monitoring role, meaning that the planning, collecting and spending of the funds must be retained at the river basin level, and all decision-making processes must include all stakeholders. This is a very clear type of self-governing sustainability of the legal entities performing these activities in a river basin. The modalities for establishment of such legal entities in FBiH (*WUAs*) and for the transfer of (property/management) rights to these legal entities from the State or the Cantons have not been explored in the Federation of BiH. In addition, in the Federation of BiH, the opportunities for financing such activities or organizations from the international sources of funding, which may be considerable and granted under exceptionally favourable conditions, have not been recognized.

The assessment of the current situation and opportunities in the area of privatization in the water sector should be conducted as soon as possible (and not later than within the following two years), so that the projection of the possibly selected solutions could be included in the detailed assessment of the SAA implementation, when a detailed assessment of compliance and implementation of all water regulations with *Community Acquis* will be made, and based on which further measures for alignment of the FBiH and BiH regulations with the EU regulations will be proposed. This would create a much better projection of the structure, manner and timeframe for transforming this segment of the water management system, and at the same time, one of the most important results of such an analytical and research-based work would be argument-based formulation of the rules and criteria for awarding concessions on public water property and infrastructure facilities.

Without previous overall and thorough analysis of these issues and the property and legal relations connected to these hydrotechnical facilities, a successful and prosperous public-private partnership

model in the Federation of BiH, which would be also fully compliant with the EU requirements set before the Federation of BiH by virtue of SAA, can hardly be expected.

4.3.3. Economic Framework

4.3.3.1. Reasons for Analyzing Economic and Financial Aspects in the Water Management Sector

Several reasons justify the interest in analysing issues related to the economic and financing considerations in the water sector. Among those, the most important ones are:

- The importance of water as a natural resource, but also as a social and economic good;
- The fact that this sector requires considerable fresh and additional financial resources,
- The need to understand funding methods and sources that are used, or may be used for water management;
- The importance of defining the role of the government and the private sector and their financial obligations related to the water management sector;
- The need to take into consideration the differences between the rural and urban areas, as well as different groups of water users;
- The need to ensure the security and provision of water through incentives provided by the government for the purpose of satisfying basic human needs, taking into account that the provision of water supply to some areas of the sector is economically justified at the macro level despite the non-profitability in terms of internal cost recovery, particularly in under privileged areas;
- The need to understand and use economic tools and to incorporate them into the water management sector in order to achieve greater efficiency and sustainable management;
- Decision makers need to know the cost of provision of water, establish long term economic perspective of water in the overall economy and determine the suitable development scenarios;
- The necessity to link performance and financing to cost recovery and to demonstrate to the users what the benefits of using sustainable management solutions are and what the impact of such actions on the economy is;
- Social and environmental cost/benefit analysis is needed in water management-related projects;
- Inappropriate practices that exist in terms of investment requirements, operation and maintenance of infrastructural facilities and equipment;
- The need to finance capacity building in water sector;
- Funding the basic water data collection and management must be sufficient to understand the nature and variations in the quality and availability of the resource;
- Needed efforts to prevent and mitigate disaster losses (floods or droughts).

4.3.3.2. Key Strategic Determinants and their Impact on the Future Business Models in the Water Management Sector

In defining the strategic commitments of the economic framework in the water management sector, the following hypotheses have been established:

Economy: Planning and management of the water resources should be integrated in the overall economic system, recognizing the key role of water for satisfaction of basic human needs, food production security, poverty reduction and ecosystem functioning and taking into consideration the special conditions of non-monetary sector economies.

Allocation: Water should be recognised as a finite, vulnerable and threatened resource, but also as a social and economic good. The costs and benefits of different allocations for social, economic and environmental needs must be clearly estimated. The use of different economic tools is of critical importance in the process of decision-making steering regarding the allocation of water for different uses.

Accountability: Efficiency, transparency and accountability are keys to water resources management, as a precondition for sustainable financial management.

Recovery of Costs: All costs must be recovered if water management, particularly in the water supply sector, is to be cost-effective and sustainable. In this area of water use, subsidies for special groups, most often the poorest ones are considered desirable and necessary. Whenever possible, the extent of such subsidies and the answer to the question who will benefit from such subsidies should be transparent. The information regarding performance indicators of water management entities, procurement procedures for implementing investment programmes, pricing, cost estimates, revenues and subsidies must be provided and delivered to all stakeholders for the purpose of achieving transparency and accountability, retaining trust and building capacities for management and investment.

Financial Resources: It will be necessary to mobilize increasingly larger financial resources for the purpose of achieving sustainable development. Demonstrating that the existing resources are being used efficiently will to a large extent help mobilizing additional financial resources from national and international sources, both public and private.

4.3.3.3. Characteristics of Successful Future Operational and Organizational Models – Strategic Objectives in Water Management in the Federation of BiH

In the light of dynamic changes in water management sector, it is possible to list some of the characteristics that the successful operational and organizational models should have in the future. Practical achievement of these characteristics features strategic commitments that should be implemented in the Federation of BiH, as well. Some of these characteristics, i.e. strategic commitments include:

- Ability to incorporate and optimally combine different levels of capacities, particularly in terms of water use;
- Ability to develop strategic partnership in the presence of increasingly larger number of stakeholders in the water management sector;
- Ability to use innovative sources of funding, while maintaining certain level of public-based funding, particularly in the areas of water protection and protection against water;
- Ability to incorporate adaptable management and incentives based on business success in order to improve operations, particularly in the areas of water supply and waste water treatment;
- Ability to involve the public in decision-making processes.

The successful business models in the water management sector will also facilitate:

- Successful management of facilities, i.e. available infrastructure,
- Adequate team building and training of the staff, as well as
- Ensuring the required professional assessments before making proposals in any water management segment.

In addition, in the future period, the Governments at different levels will have an important role in achieving the objectives set in the water management sector. As existing and new providers of water services respond to the needs of increasingly larger population, the Government will have to adjust its policies accordingly. The Governments at all levels should:

- Create conditions necessary for implementation of the required investments in the water management sector,
- Achieve objectives in terms of protection of waters,
- Achieve objectives in terms of protection against water,
- Achieve social and population health-related objectives,
- Reduce threats to security in terms of water supply, and at the same time,
- Ensure firm regulatory supervision.

Based on the above stated, the following economic strategic objectives have been defined:

Strategic Objective 2:	Adequate integration of water management sector in economic system as a whole, with larger representation of the economic tools in the process of water resources management
Strategic Objective 3:	Improving efficiency, transparency and accountability in water management
Strategic Objective 4:	Provision of financial viability in water management and reform of water pricing system along with progressive introduction of economic water price

4.3.3.4. Strategic objective 2: Adequate integration of water management sector in economic system as a whole, with larger representation of the economic tools in the process of water resources management

Water is a finite environmental resource susceptible to pollution and degradation in both qualitative and quantitative terms, and it is also a social and economic good. The allocation of scarce water resources among competing potential users has far reaching effects on ecosystems and the economic development in terms of employment and the generation and distribution of income, as well as maintaining acceptable living standard of the population. Such policies can also have significant impacts on land use planning and the movement of population from rural to urban areas. Ensuring sufficient amounts of water for basic human needs should be incorporated in the formulation and implementation of economic policies for resource development and allocation. In addition, the number of natural disasters (flood, drought) throughout the world has been rising rapidly over the past decades. Therefore, the economic evaluation for the losses due to these phenomena and financial provision for their prevention and mitigation of their detrimental effects should be of priority.

Using adapted cost-benefit analyses, market-based instruments in protection of water, pricing policies and policies for setting rates of charges for water use, as well as other economic tools is of crucial importance for efficient and fair allocation of water resources, while taking into consideration social and economic criteria, as well as basic human needs. Economic assessments should enable considering both positive and negative effects on human health and ecosystem. Inadequate economic policies inevitably contribute to the extremely poor business performance of the entities involved in water management, thus reducing their capacity to attract funding from public and private sector, national and international financial institutions.

4.3.3.5. Strategic objective 3: Improving efficiency, transparency and accountability in water management

An efficient and transparent financial management is a precondition for effective cost recovery in the water management sector, and therefore, as a part of this objective, it would be necessary to ensure transparency in terms of setting more reasonable and economically justifiable charges, subsidies, cross-subsidies and taxes, and to promote competition wherever possible. In this sense, it would be important to develop an appropriate programme of incentives for water supply companies for the purpose of implementing the measures for more efficient and more rational use of water. This would lead to a progressive transition from the existing *supply* management practice to *demand* management practice, with a vision to introduce so-called “soft path” for water. From the economic point of view, it is very important and justifiable to encourage the process of transition to a consolidated system, i.e. to regional approach to water systems, in all cases in which this approach is technically and technologically viable.

The strategic commitment of the water supply companies in the Federation of BiH should be a progressive transition to so-called *demand-side water management*, which was developed back in 1970s, as an alternative to the traditional supply-based planning. The strategic commitment should be the promotion of the idea that active demand-side water management may be more cost-effective than projecting demand on the basis of trends from the previous periods and implementation of the construction projects in order to satisfy the requirements of such projections. The objective of an effective demand-side water management programme should be to allow the users to keep all the advantages in terms of satisfying their needs for water, unless they are causing damage to the environment or endangering sustainability of water resources for other existing or future users. Traditionally the water supply companies have been focusing on developing additional supply in order to satisfy the higher demand accompanied by the population growth and economic development. Increasingly, these companies recognize that conservation programmes (of more rational and more prudent water use) can reduce current and future demand for water, and thus, provide benefits to the consumers, businesses and environment.

Taking into account that the fixed costs account for approximately 65% and 80% in the structure of total costs in the area of water supply and in the area of collection & drainage of waste water, respectively, this means that the reduced consumption would require less investments, and thus ensure larger savings. The capital costs are closely connected to the level of consumption: average and, particularly peak consumption. The experiences indicate that demand management have significant advantages.

Improved efficiency in the water management would enable more realistic assessment and quantifying of all benefits that the society has from investing in protection against waters. In this way, the mutual relations of individual beneficiaries of the limited budget funds, partially used for financing protection against water, would be more transparently and properly assessed. By preventing damages caused by water overflow from the river beds and by reducing irrational consumption and use, the accountability in terms of management of this scarce resource would be significantly improved. The principle of accountability is the basis of the sustainable water resources management, being the responsibility towards present and future generations.

4.3.3.6. Strategic objective 4: Provision of financial viability in water management and reform of water pricing system along with progressive introduction of economic water price

The importance of the adequate funding for current operations and investment maintenance, as well as for satisfying the needs in terms of new infrastructure in the area of water management cannot be overstated. The role and nature of the traditional stakeholders in water management funding is considerably changing. The public budget funds, which have been funding a large portion of water infrastructure and facilities development throughout the world, are gradually withdrawing from the current funding schemes, partly due to the bigger competition in terms of using the budget funds, and partly due to smaller funds available. Taking into account the growing financial needs, as well as the reduction of public investments in the water sector and the lack of private investments directed to this sector (only 5% of private investments monitored by the World Bank is associated with waters), the need to define new strategies in this area is becoming more and more evident. The infrastructural projects in the water sector undergo the general falling trend in lending by international, private, investment and commercial banks. The reason for this rather low level of interest rests with numerous risks specific for this sector. It is, therefore, necessary to actively promote the cooperation between the public and the private sector in order to change the perception of the foreign investors about the numerous risks, and use the funds collected by the Environment Protection Fund in a proper way.

The strategic challenge is related to the issue of collecting the required funds for compliance with the EU environmental standards. It is a well known fact that the EU has been emphasizing, since the start of the negotiations on stabilization and association, that around 90% of these costs should be covered from national sources, expecting that around 5% of GDP must be invested in the environmental projects, over a number of years, in order to cover the costs associated with the environmental issues.²⁰⁷

Strategically, in the next 10 to 15 years, the needs for capital in the water management sector of the Federation of BiH will get considerably bigger, primarily for the following reasons: (i) a large portion of worn-out infrastructure is approaching the end of its useful life and it needs either replacement or considerable investment in its maintenance; (ii) intensified efforts of the Federation of BiH to harmonize its standards with the EU standards in the water sector – more stringent standards in terms of drinking water and waste water treatment will require additional, significantly larger capital expenditures.

Setting prices is the fundamental issue that must be solved adequately if efficient water management is to be achieved. Water as a good is becoming increasingly scarce. Accordingly, the waste water treatment is becoming increasingly complex process that requires more expertise and more capital. The underlying idea of setting water prices is to facilitate the recovery of costs and to rationalize, i.e. reduce the consumption of this scarce resource by using different market incentives. If the water price is set adequately, all sectors in one economy will be using water more rationally and reduce the quantities they are consuming. Educating and informing the public about the importance of rational use of water proved to be an inadequate approach for reducing consumption sufficiently, however, if combined with appropriate water prices, this approach could be much more successful.

²⁰⁷ In 2000, the total expenditures in the environment sector in Romania and Bulgaria amounted to approximately 1.3 and 1.5 of GDP, respectively, while this share in Croatia was around 0.7%.

The differences in price setting methodologies largely came as a result of different opinions about the importance and the necessity of including economic and/or environmental externalities in the water pricing process. From the water resources allocation point of view, one of the most important aspects of the operations of a company dealing with use and protection of water is setting prices. The reason for this is because the change in pricing sends a signal to the consumers and suppliers about the changes in the consumption costs. Although, at first sight, the pricing process is not too complex, the practice shows that the water pricing process involves a number of prerequisites that should be considered. One of the most important prerequisite is determining the water value itself, taking into consideration that this value is only a starting point in the pricing process.

Setting prices, on the basis of total costs of water supply and waste water treatment services in a large number of countries is perceived as more or less a measure for ensuring the required funding. However, it must be said that there is a very small number of systems in the world that are fully funded by the current and future customers. Generally, water systems remain being dependent on the budget funds and international assistance. The future business models in the water management sector of the Federation of BiH must progressively, as its strategic commitment, adopt the transition to the pricing system based on full cost, if the financial challenges are to be adequately confronted.

4.3.3.7. Operational Objectives and Economic Framework Measures

The operational objectives, according to the economic framework for taking actions, are summarized in the table below, and described in the following text together with the measures for their implementation:

Operational objective 3:	Economically more rational and environmentally more friendly management in water sector and implementation of measures for transition from the existing supply-side water management to the demand-side water management practice
Operational objective 4:	Progressive transition to the system that would ensure long-term sustainable funding in the area of water management and full recovery of costs by customers or other sources
Operational objective 5:	Improvement of the decision-making process regarding the forms of water resources use

4.3.3.7.1. Operational Objective 3: Economically more rational and environmentally more friendly management in water sector and implementation of measures for transition from the existing supply-side water management to the demand-side water management practice

Measures:

- Establishing special water charges on the basis of international experience and comprehensive analyses of the overall social, and not only private costs and benefits, particularly in terms of determining needs, manner and level of internationalization of the significant adverse external effects;
- Implementing activities focused on raising public awareness of the importance of water, possible ways of saving and potential economic and environmental effects of the rational water use measures;
- Economic analyses of the possibility to connect rural areas to the public water supply and sanitation systems;

The measures that should be specifically implemented by public utility companies:

- Detailed analysis of the existing and reasonably required costs for the purpose of providing water supply services and the points of possible financial losses, or nature and cause of such losses, as well as the opportunities for their reduction;
- Development and application of the criteria and standards in the operations of the companies providing services in the water supply sector and sanitation, and linking it to the charges paid by the users for the services provided;
- Ensuring transparency and economic justification in terms of the charges, subsidies and cross-subsidies.

4.3.3.7.2. Operational objective 4: Progressive transition to the system that would ensure long-term sustainable funding in the area of water management and full recovery of costs by customers or other sources

Measures:

- Achieving full synchronization of the relevant laws, which would enable the Tax Administration Office to perform charge payment verification with respect to the special water charges²⁰⁸;
- Establishing the pricing system that would reflect realistic, economically, organizationally and technologically justifiable costs associated with water supply and sanitation²⁰⁹;
- Determining the possibilities for the transition to calculating the service price by applying the system of increasing block rates, with first consumption block subsidized, and the activities related to the introduction of this system which would provide for simultaneous achieving of the defined economic, social and environmental objectives in the water management sector;
- Harmonizing unit prices charged to households and business entities for water supply and sanitation services, provided that the water quality is the same;
- Increasing the special water charges and starting collecting the charges that have not been collected so far (e.g. special water charges for flood control, special water charges for abstraction of water for irrigation).

The measures that should be specifically implemented by the public utility companies are as follows:

- Specifying the prerequisites for achieving financial self-sustainability in all segments of water management, i.e. specifying certain types of costs and the total costs or full cost (operative costs, maintenance costs, amortization, capital costs, system enlargement costs, elementary effects costs, eternal effects costs, costs of water as a scarce resource);
- Analysis of potentially new and additional sources of funding for investment interventions used in other countries and assessment of the possibility to apply them in the Federation of BiH, with

²⁰⁸ Specifically, according to the Law on Water, the Tax Administration Office is explicitly mentioned as an institution having competence and obligation to control collection of these funds from the utility companies. However, this obligation does not exist in the Law on Tax Administration that defines the competences and the work of the Tax Administration Offices.

²⁰⁹ The prices that reflect the costs reflect not only the full costs of the companies providing the services, but also the differences in the costs of providing services to different types of consumers. These differences in the costs may be caused by different circumstances, such as: the type of business in which the consumer is engaged, the pollution produced by the consumer, seasonal water consumption or distance to the customer. Whichever the reason may be, the adjustment of the prices in the way that they reflect the full costs of the service is necessary in order to preserve water and other valuable natural resources in a proper way. The problematic practice that exists in BiH and other economies in transition is that the industrial consumers are charged more than the households, which can be identified as problematic practice because the result of this practice is that the consumption by the households is too large, while the industries have very little consumption or they choose to switch to their own independent water-supply and sewerage systems.

special emphasis on mobilizing the financial resources that have not been sufficiently used so far at the level of the municipalities and Cantons;

- Improvement of debt collection rate for the water supply and sanitation services provided.

For the purpose of successful reform of pricing system and achieving the economic water price, it is necessary to provide and implement the following administrative and institutional activities/measures:

- Analyzing the possibility of establishment of a regulatory body(-ies) responsible for service pricing;
- Promoting the establishment of public-private partnership in providing water supply and sanitation services, and development of the financial and regulatory instruments aiming to stimulate private investments; identifying the clearly defined roles of the State, private sector and other stakeholders.

4.3.3.7.3. Operational objective 5: Improvement of the decision-making process regarding the forms of water resources use

Measures:

- Compiling and analyzing the international experiences, good business practices and economic tools for evaluation of water used for different purposes. Establishing mechanisms for applying these practices and instruments at the appropriate levels of decision making;
- Ensuring appropriate regulatory framework, as a basis for setting concession charges for different forms of water use, starting from the objectives set out in the development documents for each of the sectors (industry, power generation sector, agriculture, population).

4.3.3.8. Funding Issue and Innovative Sources of Funding in the Water Management Sector

The infrastructural projects in the water sector undergo the general falling trend in lending by international, private, investment and commercial banks. The reason for this rather low level of interest rests with numerous risks specific for this sector, which could be summarized as follows: high capital intensity, low rates of return, very long pay-back periods, political pressure on prices for water services, widely spread conviction that water is a “free” good, inadequate legislative framework, unsatisfactory status and limited knowledge of network and user data and the imbalanced revenues and sources of funding.

The strategic challenge is also related to the issue of collecting the funds required for compliance with EU environmental standards in the areas of water protection and protection against water, since it is a well know fact that the EU has been emphasizing, since the start of the negotiations on associations, that around 90% of these costs should be covered from national sources, expecting that around 5% of GDP must be invested in the environmental projects, over a number of years, in order to cover the costs associated with the environmental issues. In 2000, the total expenditures in the environmental sector in Romania amounted to around 1.3 and 1.5% of GDP, while this share in Croatia was around 0.7%.²¹⁰. A part of these funds should be alimented by the Environment Protection Fund of the Federation of Bosnia and Herzegovina.

²¹⁰ Regional Environmental Center for Central and Eastern Europe (REC) (2003), Environmental Financing in Central and Eastern Europe, Szentendre, Hungary

The strategic commitment is that the water infrastructure and water facilities in the areas of water use, water protection and protection against water should be maintained and further developed by applying an innovative and combined funding model. Such a model implies using all available sources of funding: budget funds (Federation, Canton, and Municipality), the Environment Protection Fund, economic price of water, donations (EU pre-accession funds) and loans.

The development components of economic water price should be promoted through adopting appropriate legal regulations, in case they have not been adopted yet: (i) development charge – local public funds that are charged to the users of water supply and drainage services in the service area; (ii) water use charge and water protection charge - public funds that are charged to the users of water supply and drainage services on the entire territory of FBiH and (iii) a portion of value added tax that is charged on the municipal services. If, for any reason whatsoever, the budget funding is insufficient, the latter component (VAT on water services) should be insisted on, because it *is* an integral part of the economic water price.

The Federal and the local development programmes should strive to develop the infrastructure by using the local public funds as much as possible (as the least expensive funds) supported by the EU fund donations and other donors, and whenever possible to avoid loans (as more expensive funds) or private partners funds (through BOT, DBOT and similar model) because this type of funding is the most expensive one.

4.3.3.9. Public-Private Partnership in the Water Management Sector – Strategic Challenges and Possible Solutions

In the process of involving the private sector, it would be possible to allow the privatization of so-called *operational function in the municipal water sector*, provided that the cost-effectiveness requirement is satisfied, which means that the water resources themselves cannot be sold and therefore cannot be subject to the privatization. It is possible to allow investments in development of the water infrastructure by a private operator only once the requirements of consumptiveness and purposefulness are satisfied. The privatization of operational function, primarily, involves:

- „En affermage“ concession model: awarding concession for the system operator function without right to invest, provided that the cost-effectiveness requirement has been satisfied. The cost-effectiveness requirement may be considered satisfied if the private management (with equal supply standards) of the users is more cost-effective than the public one.
- „En affermage“ model could turn into „en concession model“, i.e. awarding concession for the system operator function with right to invest, provided that the requirements of consumptiveness and purposefulness are satisfied. The requirement of consumptiveness will be considered satisfied once the combined funding model is exhausted. This model may become exhausted (i) once the infrastructure is well-developed or (ii) once the development cannot be achieved within the planned period, any longer.

In the first case, the operator's investments are reduced to maintenance costs. In the second case, the operator would be entitled to participate in the development investments. The requirement of purposefulness may be limited to development of plants for drinking and waste water treatment being the investments that are most likely to attract the private capital.

The following additional requirements must be set:

- Any private concession partner must be brought in the same position as the local service providers, instead of favouring them with special clauses (this particularly applies to foreign currency clauses, sliding scales and inflation indices);
- Any investment made by the private partner must be subject to approval of the public partner. Overinvestment or fictitious investment lead to the increase in service prices and debtor's dependency;
- Any rehabilitations and reinvestments by the private partner must be conducted strictly according to the agreed plan. They must be equally distributed over the concession period instead of being carried forward to the end of that period when it is more cost-effective for the concessionaire to terminate the contracts than to abide by them;
- Giving preference to the models according to which the public function is clearly separated from the private one, rather than highlighting the "public-private partnership". Interdependencies between the public and the private within the operational function, basically, seek to divide the responsibilities, where the responsibility must rest solely with the private partner (usually through involvement of the public partner in different models of operational management, where the concessionaire must have special obligations and responsibilities);

It should be emphasized that it is to be expected, as is already happening, that the public private partnership is implemented in urban, but not in rural areas. Examples of such partnerships can be already found in the countries of Southeast Europe, however, the experiences are very diverse. According to the Camdessus Group: *"Involving a private operator in a country with no experience in this area is a long and difficult process. Compared with other types of infrastructure, the water sector is the least attractive for private investors and the invested amounts are minimal. Only 3% of the population in poor or emerging countries is served through fully or partially privately owned operators"*.

4.3.3.10. Economic Water Price

The economic water price principle is one of the postulates of the Water Framework Directive (WFD). The term "water price", for the purpose of this Strategy, means any pecuniary expenditure charged for a cubic meter (or other unit) of water supplied to the end-users, which is either directly or indirectly associated with the protection of water quality and quantity and the development and management of water infrastructure facilitating water use and/or discharge in accordance with environmentally acceptable standard.

The strategic commitment is that the water price must include price components whose rates ensure availability and protection of water source, as well as the sustainable development of water infrastructure. These elements or components of the economic water price are presented in the table below:

Component	Revenue	Character	Purpose	Level of Collection	Level of Consumption
Price of municipal water supply service	Service provider	Price	Management and operation of the water infrastructure	Service Area	Service Area
Price of municipal draining service	Service provider	Price	Management and operation of the water infrastructure	Service Area	Service Area
Price of municipal water treatment service	Service provider	Price	Management and operation of the water infrastructure	Service Area	Service Area
System development charge	Water Agency and Cantons	Public duties	Development and enlargement of water infrastructure	Service Area	Canton
Water protection charge	Water Agency and Cantons Environment Protection Fund	Public duties	Protection of water quality resource and development of water infrastructure	Canton	Service Area
Water use charge	Water Agency and Cantons Environment Protection Fund	Public duties	Provision of water resources quantities and development of water infrastructure	Canton	Service Area
Value Added Tax	Budget	Public duties	Various	BiH Federation	Various

Table 4.3.3.1: Economic water price structure

There is an opinion that the consumers are used to having water subsidized²¹¹. According to a study developed in the EU²¹², if the pricing would be actually at the level that provides for full cost recovery, meaning that if the actual economic price would be introduced, the share of family income spent on water sector services would be increased from the current 0.3 – 1.2% to 1- 3 %, which tells enough about the current underrating of this scarce resource.

The necessity to carry out the economic analyses on water use in accordance with the provisions of the Annex to Framework Water Directive stipulating the following in the form of a standard: *Member States shall take account of the principle of recovery of the costs of water services, including environmental and resource costs, having regard to the economic analysis (conducted according to Annex III of the Directive), and in accordance in particular with the polluter pays principle.* According to this, the tasks of Member States by 2010 are as follows:

- that water-pricing policies provide adequate incentives for users to use water resources efficiently, and thereby contribute to the environmental objectives of the WFD;
- an adequate contribution of the different water uses (disaggregated into at least industry, households and agriculture) to the recovery of the costs of water services, based on the economic analysis (conducted according to Annex III of the WFD) and taking account of the polluter pays principle;
- Member States may in so doing have regard to the social, environmental and economic effects of the recovery as well as, the geographic and climatic conditions of the region affected;
- The water price must not contain irrationalities in municipal activities: organizational, (fragmented and inefficient municipal water sector) and technical (large losses of drinking water in the system) and the components that are not in the function of water management.

²¹¹ Avis, C., Tydeman, C. and Royo Gelabert, E. (2000). What Role for Water Pricing? Ten Actions for Internalizing Sustainability, WWF, Brussels

²¹² Seppala, O.T. and Katko, T.S. (2003). Appropriate pricing and cost recovery in water services. Journal of Water Supply: Research and Technology – AQUA, 52, 225–236

4.3.3.11. Funding based on Water Charges and Revenues Generated by Lease of Public Water Property

In the Federation of BiH, apart from the basic water price, different charges, which have the character of the public revenue or other public revenues, are being collected, and the revenues generated by the lease of public water property are also collected. Pursuant to the “Decision on Special Water Charges”, the special water charges are collected for:

- the use of surface waters and groundwater,
- the use of water for the purpose of generating power,
- protection of water,
- the extraction of material from watercourses,
- the protection against adverse effects of water.

According to the LoW of the Federation of BiH, the revenues generated by the lease of public water property on Category II surface waters is to be fully allocated to the Cantonal budget.

4.3.3.11.1. Special Water Charges for the Use of Surface Waters and Groundwater

4.3.3.11.1.1. Water Use Charge

The special water charge applicable to public water supply is set to the amount of KM 0.01 KM per m³ of abstracted water. However, the strategic commitment in this segment should be to increase this amount. It is evident that the water supply companies are not sufficiently motivated to use the resource being entrusted to them in a more rational manner. According to the previous law, the companies were paying the water charge for using the water resource at rate of 0.05 KM per m³ of the supplied water. According to the most recent Law on Water of the Federation of BiH, this liability has been reduced to 0.01 KM per m³ of abstracted water. It is obvious that the end result is negative, for the simple reason that, given the large losses of water, the companies are now in a better financial position because their total expenditures on this basis have been reduced. The basis for calculation has been increased 3 times; however, the charge has been reduced 5 times. This situation should be changed (i.e. the water abstraction charge should be increased) because it is completely unmotivating with respect to more rational use of water. Taking into consideration the significance of these companies, their presently exercised monopolistic right to use this scarce resource, as well as the volumes of water they are using, it is clear that this arrangement is not in compliance with the main requirement stipulated in the LoW of the Federation of BiH, which emphasizes that the water resources management must be organized in accordance with the principles of sustainable water management and preservation of scarce water resources.²¹³

4.3.3.11.1.2. Charge for Abstraction of Water and Mineral Water Used for Water Bottling

In terms of abstraction of water and mineral water used for water bottling, the special water charge has been set to the amount of KM 2 per m³. So far, this charge amounted to KM 0.05 per m³, but because of the commercial value of water as a commodity, this charge has been increased. This charge should be significantly increased, taking into consideration the fact that the retail price of water is around 1 to 1.5 KM per 1 liter, which practically equals to approximately 50% of the price of oil.

²¹³ By comparison, let us say that the water use charge calculated on the basis of the water supplied and charged in Croatia amounts to 0.80 kuna/m³, which is 0.20 KM (according to the middle exchange rate of 4.1 kuna per 1 KM, on 6 June 2008). The water protection charge is 0.90 kuna /m³, which is 0.22 KM.

4.3.3.11.2. Funding Drainage and Irrigation for the Purpose of Land Improvement

In Bosnia and Herzegovina there are no developed irrigation systems, and only around 0.65% of agricultural land is irrigated. The existing irrigation systems are damaged because of the war and negligence. Most of the flat areas in the northern part of the country used as arable land contain high percentage of humidity and should be drained.

The decision on special water charges for the abstraction of water intended for irrigation stipulates the charge to the amount of KM 0.01, as opposed to the earlier amount which was KM 0.05 per m³. Due to the difficulties in the agricultural production, this charge would be annulled, i.e. it would be equal to zero until further notice. In the future period the options for re-imposing this charge should be certainly taken into consideration. The reason for this is that the water in agricultural sector is used inefficiently and there is no motivation to improve the efficiency of such use. In the world, a great attention is paid to the water pricing and its use in agriculture, and therefore, there are well developed and diverse models, some of which are mentioned below:

Pricing models for irrigation and drainage for the purpose of land improvement: In the strategic consideration of water valuation in the sector of agricultural production, it is necessary to pay attention to the following facts. The economic tools used in the agricultural sector for the purpose of strategic water demand management are evaluated on the basis of two main criteria: the pricing structure and method, and the level of water prices for irrigation. The pricing system that is based on the volume of water used, i.e. volumetric pricing, which in theory should be a motivation for using water rationally and sparingly, will produce the expected results only at such level of water prices at which the water user is price-sensitive. This price level depends on numerous factors: costs of irrigation service, irrigation technique applied and value added in the production of agricultural products.

The extreme case, where structure is of little importance, is where water is free (Egypt and Albania), which does not encourage water saving at all. At the opposite extreme, Israel has introduced a pricing structure giving high incentive to save water with an increasing block rate pricing structure. Between these two extreme situations, different methods of irrigation water pricing can be used (in increasing order of effectiveness):

- area pricing system;
- area pricing system depending on the crop being irrigated, method of irrigation or other criteria;
- uniform or two-part volumetric pricing system, based on the volumes of water consumed;
- increasing block rate pricing system.

The basic characteristics and experiences in application of the above-listed pricing systems that should be taken into consideration in terms of the strategic commitment in this segment of the water sector in the Federation of BiH are as follows:

The area pricing system – the method of using a flat rate per hectare is often applied for gravity-fed systems (Spain, Italy, Greece, etc.) and it may well influence the decision whether to use irrigation or not, but not the quantity of water applied per hectare. Combined with a very low price and subsidies for irrigated crop, this method of pricing has significantly encouraged the extension of the irrigated areas and the increase of the demand for irrigation water in those countries. This pricing method is most commonly encountered when certain improvements are required so as to persuade farmers to start applying irrigation measures.

The area pricing system depending on the crop being irrigated, method of irrigation or other criteria does not encourage water saving for a given choice of crop or irrigation technique, but it does have more on the choice of which crops to irrigate or which irrigation technique to adopt. This pricing method can be used to discourage the irrigation of certain crops for example, by applying a higher price to crops that consume a large volume of water.

The uniform or two-part volumetric pricing system, based on the volumes of water consumed is the only method to actually encourage water saving. The system of increasing block rates, where the price of water increases according to the volume consumed can indeed have a strong effect leading to decrease in the consumption of water, depending on the progression of the prices and their absolute level, but it is seldom applied to irrigation (Israel, Jordan). However, it should be emphasized that the absolute level of prices largely determines the effectiveness of the pricing system implemented. The simpler volumetric method with a flat or two-part tariff may be more effective than the increasing block rate pricing system, provided that the absolute level of average price is higher.

The European Water Framework Directive requires in this segment as well, that the scarcity of natural resources and the environmental aspects must be taking into account when determining the structure and the level of water prices. The response to this requirement involved setting up new institutions (such as the specialized Agency in Morocco) or technical and economic tools (based on polluter-pays or consumer-pays principle). Thus, some countries (France, Spain Italy) charge a water tax/fee for irrigation water, but the levels of fee remain relatively low.

Potential funding sources for the projects of drainage and irrigation for the purpose of land improvement

The required funds for financing the projects of irrigation and drainage may be potentially collected from the several sources, as follows:

- Budget funds (the Federation, Cantons, Municipalities of City);
- EU Pre-Accession Funds;
- Government-backed commercial loans;
- Local administration (e.g. bond issuing);
- System users.

The charge for abstraction of water for industrial processes, including thermal power plants: The charge for abstraction of water for industrial processes, including thermal power plants amounts to 0.03 KM per m³. The thermal power plants will, in the future, pay this charge per m³ of water abstracted, and not per kWh of electric power generated, which is now the case. It is considered that this charge should be based on the water consumed that can also be recycled by the thermal power plant in the generation process²¹⁴.

4.3.3.11.3. Special Water Charges for the Use of Water for the Purpose of Generating Power

The special water charge for the use of water for the purpose of generating power amounts to 0.001 KM per kWh of the electric power generated. So far, this charge has been based on a percentage (2%) of the ex works price for 1 kWh of the electric power generated. Every year, JP Elektroprivreda BiH and JP Elektroprivreda Herceg Bosna were obliged to deliver the generation

²¹⁴ The initiative for the change of the charge basis related to water use by thermal power plant was made by the electricity companies.

prices charged for 1 kWh based on which the water charge was paid. To simplify the payment system, this charge was determined in a flat amount per kWh generated. After recalculating the payments made so far, this charge was increased by up to 50%. This charge should be even higher in the future. Water is the basic input factor for electric power generation and for this reason, this charge was increased²¹⁵.

4.3.3.11.4. Water Protection Charges

A part of the water protection segment is financed from a part of the funds generated by collecting the general and special water charges, being particularly the part allocated to:

- The Cantons (collectors for receiving and transporting the waste waters, waste water treatment plants, discharges to the recipient and other associated facilities and equipment);
- Federal Environment Protection Fund (for co-funding the infrastructure used for the protection of waters of relevance for the Federation of BiH).

The other part of the water protection segment is financed from the funds generated by collecting the special water charges. The basis for collecting the special water charges is contained in the polluter-pays and consumer-pays principles implying that a water polluter should pay the costs of treatment of the discharged polluted waters, and that a water consumer should pay for the use of water being a common good.

The experiences of some European countries in terms of the rates for special water charges for water protection imposed on all water polluters – industry, individuals and all other polluters, are quite interesting. The effluent charges, being one of the economic tools used in the environmental protection, may be based on the composition (type and concentration) of the pollutant. In France, for example, the charge is levied on the eight types of pollutants deemed most dangerous and difficult to treat (heavy metals, phosphorus, soluble salts, etc.). The charge is calculated as a function of pollution produced during the period of maximum activity on a normal day. In other cases, the charging formula involved can reflect the costs of treating a particular effluent, or the environmental sensitivity of the receiving waters.

The special water charge for water protection applicable to importers and manufacturers of artificial fertilizers amounts to 0.005 KM per 1 kg. This charge remained the same, which is not justifiable, given the negative external effects. In other words, the costs caused by using the artificial fertilizers are much higher than the above-mentioned amount – 5 KM per one ton of fertilizer.

4.3.3.11.5. Charges for the Extraction of Material from Watercourses

The charge for extraction of material from watercourses amounts to 1.50 KM per m³. The value of this charge has also been underrated and it should be increased.

²¹⁵ By comparison, this charge in the Republic of Croatia amounts to 7.5% of the generation price for 1 KWh. In Switzerland this charge is collected by the Cantons and it is set at the level of 52 EUR per KW of the total installed hydro power plant capacity regardless of its costs structure or the capabilities of generating total income.

4.3.3.11.6. Funding of the Protection against Adverse Effects of Waters – The Flood Control

In the area of funding the protection against adverse effects of waters, there are three possible funding models:

- From the budget – according to the “general solidarity” principle (i),
- From the earmarked charges collected from the target user categories – according to the “consumer-pays” and “common solidarity” principle (ii) and
- Mixed, including both, where one source of funding is principal and the other one is auxiliary, or they may be set on equal basis (iii).

Ad (i). The budget model of funding, through general solidarity of all tax payers is not always the most reliable mode. The fundamental problem with this model is how to reconcile two different perceptions of the budget planners who, as a rule, tend to find the funds necessary for investment undertakings, while treating maintenance requirements as budget saving items. When the compliance of these two perceptions is not assured, as a rule, the other, safer model is resorted to.

Ad (ii). The modern fiscal practice provides the funding model through strictly earmarked revenues collected from the target user categories. The basis of this model is composed of two principles: the user-pays principle and the common solidarity principle. Definition of the users of the system for protection against adverse effects of water is not always unambiguous. (That other societies have their own doubts about this demonstrate the two examples of Austria and the Great Britain given below). However, it is widely accepted approach that the primary protected good is - property, and the owner of this property is recognized as the user and accordingly, the tax payer. However, reducing this definition to the property owners only in a flood plain would mean the exclusion of the taxes on direct flood victims. Therefore, the consumer-pays principle is adjusted with the solidarity principle applicable to all property users (common solidarity), either at the national level (broader solidarity concept), or at the level of river basin district (narrow solidarity concept)²¹⁶.

Ad (iii). The mixed funding model can be implemented by combining the budget funding for development and maintenance of the watercourses of relevance for the Federation of BiH and the funding for maintenance of local watercourses from the revenues generated by collection of the water charges. The application of this model is under discussion in some highly developed countries of the EU²¹⁷.

Count VI in the „Decision on Special Water Charges in the Federation of BiH“, lays down the levels of special water charges intended for flood control in the areas where the water control facilities have been erected, depending on the real property being under protection:

²¹⁶ In certain countries the funding system is autonomous, but it is linked to other existing public duties by means of calculation and collection methodology. One example is the Republic of Austria, where according to the Federal Law on Protection against Disasters, the funds for protection against adverse effects of water are generated through a percentage of the profit tax and personal income tax.

²¹⁷ An example is the Great Britain where the Flood (and Coastal) Defence Programmes are funded from the Treasury; however, the following additional water charges are under consideration: (1) charges on the property exclusively located in the flooding areas (Flood Plain Levy, as the levies generically identified as Charges on beneficiaries), which was assessed as a solution that would cause “many hostilities” because “it burdens the victims of floods who in addition to coping with flood problems have problems with the insurance companies and general decline of property values” and (2) charges on investments, i.e. Charges on Development, both in the flooding areas and outside them because “any development creates problems with flooding”. (DEFRA, Flood and Coastal Defence Funding Review, Report on the Outcome of Consultation; October 2002)

- In sub-count 1, the level of the special water charge for flood control applicable to the owners of agricultural, forest or construction land has been determined to the amount of 5.00 KM per 1 ha,
- In sub-count 2 the level of the special water charge for flood control applicable to the owners of residential, business and other buildings has been determined to the amount of 0.10 KM per 1 m².

The special water charge for flood control has not been applied in practice yet because the requirements and the information necessary for its implementation and payment have not been provided. In the next planning period of the Water Management Strategy it will be necessary to start collecting these charges in practice.

4.3.4. Institutional Framework

The following strategic objective has been defined for the actions to be taken within the institutional framework in terms of the water sector organization and administration:

Strategic Objective 5:	Efficient institutional organization and administration capable of implementing the accession process and implementation of EU requirements in the water sector
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4.3.4.1. Strategic objective 5: Efficient institutional organization and administration capable of implementing the accession process and implementation of EU requirements in the water sector

There are two main determinants of the further development of the water management institutions in the Federation of BiH:

- The Law on Water of the Federation of BiH²¹⁸, Article 21 stipulates: *Water management shall be the competence of Bosnia and Herzegovina, the Federation, Cantons, towns and municipalities.* Article 22 summarizes water management objectives: *the achievement of good status or good ecological potential of surface and ground waters, or water and water-related eco-systems, the reduction of damages caused by various detrimental effects of water, the provision of sufficient quantities of water of adequate quality for different purposes, and the promotion of sustainable water use taking account of the long-term protection of available water sources and their quality.* The Law also lays down the territorial basis for water management (Article 23, paragraph 1): *The main territorial unit for water management shall be the river basin district*, and for the purpose of water management, the following two basin districts have been established: The Sava River Basin District and the Adriatic River Basin District. The associated river basin district agencies (Article 152) have been established to carry out water management tasks.
- *The process of the BiH alignment and approximation to the European Union (EU).* This process has been significantly strengthened by signing the Stabilization and Association Agreement (SAA) with the EU on 13 June 2008. This is the third generation of the European agreements offered to the countries of the Western Balkans within the Stabilization and Association Process. The Agreement was signed on an indefinite period of time aiming to contribute to the economic and political stability of Bosnia and Herzegovina, confirming the status of a potential candidate country. By this, BiH enters into the contractual relationship with the EU with the task to implement the provisions of the Agreement and to continue further activities and fulfilment of the criteria for full EU membership. After signing the SAA, the next step for BiH is obtaining the status of candidate country for EU membership. Until then, BiH is tasked with development of the

²¹⁸ Official Gazette FBiH, No. 70/2006

SAA implementation plan, which will together with the priorities set out in the European Partnership within the EU Integration Strategy for BiH constitute the EU Integration Programme for BiH. It is evident that the upcoming period and the twelve-year Strategy planning period will be filled with the necessary reform processes, which involves the water sector and the environment, in order for BiH to align and satisfy the EU membership requirements.

The Agreement stipulates that the BiH association is to be realized over a transitional period of a maximum six years (in 2014)²¹⁹, meaning that the BiH membership in the EU will be realized within the Strategy planning period. The environment section of the Agreement²²⁰, in which the water management sector is mentioned, states that the Parties shall develop and strengthen their cooperation in the environmental field with the vital task of halting further degradation and start improving the environmental situation. Furthermore, the Agreement lays down the requirement to develop strategies to significantly reduce local, regional, and trans-boundary air and water pollution and to establish a system for efficient, clean, sustainable and renewable production and consumption of energy, as well as to develop the strategies related to environmental impact assessment.

Both of the above mentioned determinants are compliant with the water management policy defined for the EU countries and the European countries that are, like our country, in the process of approximation to the EU membership or accepting this method of water management according to their geographical position.

The instructions provided in the *Guide to the Approximation of European Union Environmental Legislation*²²¹ (it was designed as an instruction for the Central and Eastern Europe countries that were on the way to their full membership at that time /1997/, and it is still applicable to our country) lay down the necessity of establishing at least one national/state institution for relations with EU for the purpose of implementation of the European environmental legislation. The issue of necessity to establish the national agency for environmental protection is emphasized in paragraph 4.3.2 - The Legal Framework, i.e. in paragraphs 4.3.2.2.3. Pending establishment of such a national agency, these tasks are partly performed by the Directorate for European Integration of Bosnia and Herzegovina (Directorate) as the permanent body of the Council of Ministers. The Directorate was established pursuant to the Law on Council of Ministers²²² with the task to coordinate the European Union integration process of Bosnia and Herzegovina. The Directorate has the following competences: (i) coordinating activities on harmonization of the BiH legal system with the accession criteria for BiH; (ii) verifying compliance of all draft laws and regulations delivered to the Council of Ministers by the ministers and other administrative organizations, with the directives from the White Paper, (iii) harmonizing the activities of the authorities and institutions in BiH related to the appropriate activities required for the European integrations; (iv) coordination over the implementation of the decisions made by the competent authorities and institutions of BiH with respect to all activities required for the European integrations; (v) acting as the main operational partner of the European Commission institutions in the stabilization and association process; (vi) coordinating the European Union assistance. Other tasks of the Directorate are participating as the technical and operative body in the contacts with the European Commission and participating in the activities or development of draft laws, regulations and guidelines related to the process of joining the European integrations.

²¹⁹ Article 8, Stabilization and Association Agreement

²²⁰ Article 108, Stabilization and Association Agreement

²²¹ Guide to the Approximation of EU Environmental Legislation, European Commission, 1997.

²²² Official Gazette of BiH No. 38/2002 of 18 December 2002

The EU requirements related to the institutional organization are generally defined in the WFD, Article 3: „Member States shall ensure the appropriate administrative arrangements, including the identification of the appropriate competent authority, for the application of the rules of this Directive within each river basin district “. In terms of *water quality* section, the EU legislation *concerning environment* contains only a few requirements associated with the institutional organization²²³. The legislation establishes the standards that are to be satisfied, the procedures to be followed, etc. Generally, it is up to the Member States to establish new or reorganize the existing institutions that would fulfil the above-mentioned requirements, and therefore, these institutions are not tasked to strictly follow the EU requirements, but also to work in accordance with the particularities of each Member State. Several direct EU legislation requirements in this matter, that are more in the form of indirect recommendations, are as follows:

- *Characteristics of the responsible institutions:* The EU environmental legislation provides no particular requirements regarding the levels at which the responsible institutions are to be established, either at the national or local level. Certainly, some activities are best implemented at the national level, while some require to be realized at the local level. The tasks of the responsible institutions involve implementation of planning, monitoring, reporting, licensing, prescribing quality parameters, inspections, public informing and acting in incident situations.
- *Institutional aspects of licensing and inspection:* The task of the responsible institutions, prior to the licensing procedure, is to develop the quality management plans and programmes for, in this case, water medium in accordance with the following directives, WFD, Directive on Groundwater, Directive on Environmental Impact Assessment, etc. The staff of the responsible institutions must possess the strategic understanding of the processes affecting the environments and particularly of the sensitive parts of the environment. The task of the responsible institutions is also licensing. The licensing model is based on EU legislation establishing emission limit values for different processes. It is up to these institutions to organize, independently or based on external contracts, the appropriate levels of monitoring. The institutional division of the licensing function and the inspection one is recommended.
- *Support by professional institutions:* The established institutions need the support of professional and scientific institutions capable of implementing special tasks (monitoring of industrial polluters, etc.).
- *Skilled, experienced and trained personnel:* The application of the environmental legislation requires professional qualifications within the institutions, including: law, chemistry, technical engineering, data processing, development and application of databases, communication, economics, communicationology, etc.

4.3.4.2. Operational Objectives and Measures for Institutional Framework

On the basis of the defined strategic objective of the Strategy, the institutional framework operational objectives have been defined and they represent concrete and measurable changes that will be achieved through implementing appropriate measures. The operational objectives for the institutional framework are as follows:

²²³ Environmental policy in the candidate countries and their preparations for accession. Institute for European Environmental Policy, 2001

Operational Objective 6:	Institutional strengthening of the water sector in the Federation of BiH
Operational Objective 7:	Capacity building
Operational Objective 8:	Intensification of cooperation with other sectors associated with water
Operational Objective 9:	Establishment of reference and authorized laboratory(-ies) for water quality testing
Operational Objective 10:	Improvement of alert system and efficient responding in cases of accidental water pollutions and water pollution emergencies

4.3.4.2.1. Operational objective 6: Institutional strengthening of the water sector in the Federation of BiH

Measures:

- *Strengthening human resources in the Ministry of Agriculture, Water Management and Forestry of FBiH (FMAWMF), with Water Agencies, as well as the relevant Cantonal Ministries.* The planned EU association process that will be implemented progressively over a transitional period of 6 years involves a range of extensive tasks for the water sector institutions. Even at the present time, the staffing in these institutions is not compliant with the plans of the Federal and Cantonal ministries.
- *Encouraging development and training institutions providing professional support to FMAWMF, as well as the Cantonal ministries within the scope of their responsibility.* Performing activities that fall under the competence of the Federal and Cantonal Ministries within the sustainable water management involves more intensive cooperation with the associated professional institutions. Above all, the institutions such as Sava RBD Agency and the Adriatic Sea RBD Agency; the Federal Hydrometeorological Institute; the Federal Institute for Agropedology; and the Federal Institute for Geology, should be staffed and strengthened in accordance with the adopted plans. The mutual cooperation needs to be intensified. The particular emphasis is given to the necessity to provide support for the development of the Water Information System (WIS), in accordance with the specific objectives related to the establishment of the Water Information System²²⁴, particularly in terms of the information sharing with the external and international institutions. It is necessary to support the activities of the Environment Fund. It is necessary to define the method of data delivering and processing, and establish cooperation between the Federal Office of Statistics and the professional institutions in the water sector, on a permanent basis.
- *Institutional and human resources strengthening of the public utility companies within public water supply and sanitation.* It is necessary to create conditions and promote the appropriate staffing, as well as to encourage strong institutional links between the public utility companies and the Cantonal ministries and, particularly the professional institutions within the water sector. Implementation of this measure will lead to stable local public utility companies that are capable of managing the water supply and sanitation infrastructure efficiently.
- *Setting up and training the teams for managing and implementing water sector-related projects – PPU (Programming and Planning Units).* The setting up and institutional arrangement of these teams, within the structure of the BiH institutions, has been planned within the WQM II Project,²²⁵ aiming to facilitate planning and implementing the strategy of investment in the water sector. These Units, which should be institutionally linked from the entity level to the level of the Council of Ministers, are tasked to manage the activities on preparation, prioritization, and implementation of the infrastructural projects in the area of environmental protection, on a cost-

²²⁴ Article 98, Law on Water of the Federation of BiH

²²⁵ Water Quality Management in BiH – WQM II, EU Cards Project, Consortium Grontmij/Carl Bro/REC BiH, 2008

effective basis, focusing on the projects related to the collection, transport and treatment of waste waters.

- *Development of the central database on the status of surface waters and groundwater quality and the obligation to report to all public organization, as well as the registered polluters.*
- *Establishing the cooperation among different management structures related to the commitment of reporting on the status of water and the status of water management in the Federation of BiH, according to the requirements of the international commissions, to the competent institutions at the BiH level.*
- *Establishing and staffing of the Cantonal Inspection Offices.* The Federal Inspection Office - Water Management Inspectorate²²⁶, was established on 1 January 2007, however, the staffing has not been completed yet. It is necessary to complete the establishment of the Cantonal Inspection Offices, i.e. to set up the water management inspectorates and to train the staff.

Establishment of the Advisory Councils for the Adriatic Sea River Basin District and the Sava River Basin District. The establishment of the Advisory Councils for the River Basin Districts is stipulated in the Law on Water, Article 164, for the purposes of considering the systemic water management issues of relevance to a river basin district, different demands and interests, and proposing measures for the development and improvement of water management. According to the Law on Water, these Councils are to be established by the Federation Government, and it defines the composition, role and the future activities of the Councils. The role of these Councils in the anticipated accomplishment of the institutional strengthening objectives in the water sector is important because it represents the best link of cooperation between the Federal and Cantonal ministries, on one side, and the stakeholders on the other. These Councils provide for achievement and institutionalization of one of the sustainable water management principles – public participation in decision-making processes, and at the same time, it facilitates avoiding non-institutional and parallel consideration of the objectives and decisions that are of interest for all interested parties i.e. persons, both physical and legal. This, to a certain extent, fulfils the requirements of the Aarhus Convention associated with access to information and public participation in decision-making in environmental matters²²⁷.

4.3.4.2.2. Operational objective 7: Capacity Building

Measures:

- *Enhancement of the cross-cutting representation in the water sector institutions*, in accordance with the WFD requirements. The analysis of the current skilled personnel structure within the human resources indicates that there is an under-representation of certain types of required experts. This is particularly related to both the Cantonal ministries and the Federal one. The upcoming period, with the tasks included in the progressive association process over a transitional period of a maximum six years, puts numerous tasks before these institutions. The existing personnel structure in the water management institutions must be strengthened with the

²²⁶ The official name taken from the rulebook of the Federal Inspection Office.

²²⁷ Convention on access to information, public participation in decision-making and access to justice in environmental matters, adopted in 1998 in Aarhus, Denmark. (In Bosnia and Herzegovina, the ratification procedure of this Convention is currently in progress). Article 1 states: *In order to contribute to the protection of the right of every person of present and future generations to live in an environment adequate to his or her health and well-being, each Party shall guarantee the rights of access to information, public participation in decision-making, and access to justice in environmental matters in accordance with the provisions of this Convention.*

professionals in water law, economics, and all other professionals required for the implementation processes associated with the water management approach compliant with the WFD. Special attention should be paid on the capacity building in the cantonal ministries, since the development of local personnel makes the basis for sustainable water management. In the water sector institutions, special emphasis needs to be given to the promotion of this sector, particularly within the educational institutional and pointing to professional challenges involving work in this area, in terms of different professional profiles.

Mandatory and continual professional upgrading of the water sector professionals; deficiency of the professionals, that has been already recorded in the Federation of BiH, is the problem facing many countries. This problem will become more evident with the EU association process, when the institutions will face tasks in which they are inexperienced, and therefore the question of professional upgrading of the existing personnel is unavoidable and it is not a matter of personal ambitions. A key to sustainable water resources management is the existence of skilled and well trained personnel in all of the disciplines needed in the planning, development, and management processes. The water resources management should progressively, and in some cases completely rely on the local personnel in terms of all required professional profiles. The development of local professionals is one of the most essential long-term conditions required for successful sustainable water management²²⁸. One of the methods to implement these measures involves annual training programmes for water sector personnel, which need to be developed every year on the basis of the status and annual plans.

Organizing and implementing the training programmes for larger industrial polluters; The water sector recognizes the industry both as a user and as a polluter of waters, but primarily as a *stakeholder* that should be involved in the decision making processes either indirectly, through the competent ministry, or directly. For the water sector the industry is a partner with the following common objective: to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater²²⁹. The planning period of this Strategy will require setting new and specific requirements for industrial polluters which involves not only the control of effluents, but also the changes in the production processes themselves.²³⁰ In cooperation with the industry, it is necessary to organize the development of the annual training programmes for the purpose of preventing pollution, which is also stipulated in the Environment Protection Strategy (December 2007).

4.3.4.2.3. Operational Objective 8: Intensification of Cooperation with Other Sectors Associated with Water

Measures:

- *Intensifying the inter-sectoral cooperation:* The scope of work of the water management sector, given the significance of this resource, to a certain extent overlaps the other activities and in this matter, it should be given a special priority. This statement arises from the functional nature of the water infrastructure facilities or the systems that depend on the issues associated with the locations and space necessary for their functionality and development. Therefore, this makes the basis for priority setting, particularly in terms of spatial planning, to be able to respond to the requirements of water management in terms of protected areas, sanitary protection zones of

²²⁸ Sustainable Water Resources Management, D.P. Loucks, International Water Resources Association, 2000.

²²⁹ Article 1., Water Framework Directive 2000/EC of the European Parliament

²³⁰

- Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control (IPPC Directive);
- Directive 2001/42/EC of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment

drinking water sources, etc. Intensifying the inter-sectoral cooperation is, as a measure, recognized by other sectors as well (in the environment sector, the Environment Protection Strategy stipulates establishment of a permanent inter-ministerial cooperation body), because following their respective sectoral strategies, they all have encountered the problem of insufficient cooperation and information sharing. Obviously, this is associated with insufficiently implemented requirements of the *good management practice*. The scope of work of the water management sector is particularly susceptible to the lack of intensive inter-sectoral cooperation, since the integrated water resources management involves social, economic and environmental aspects²³¹, i.e. the cooperation with the sectors of environment, economy, agriculture, etc.

- *Promoting integrated water management principles into other sectors, primarily the sectors of agriculture, energy and environment protection*²³²; the integrated water management principles, promoted by the Dublin Convention, should be promoted and introduced in other sectors that are on different basis associated with the water sector. Participation of these sectors in creating water sector development is implied in the integrated water management, and therefore it is necessary to have these principles incorporated in those sectors, in the following ways:
 - *Agriculture Sector*: (i) using water more productively and more cost-efficiently; (ii) productivity of water use should be analysed at the level of a river basin or sub-basin, and not according to the size of agricultural area; (iii) linking water sector reforms with those in agriculture, particularly from the aspect of irrigation, and giving emphasis to the importance of water resources; (iv) intensifying the participation of water users through establishing associations;
 - *Energy sector*: (i) introducing commercial energy prices; (ii) stimulating and supporting competition among energy suppliers; (iii) strengthening participation of the private sector in its partnership with the public sector; (iv) development of a transparent energy sector legislation; (v) promoting positive experiences in energy sector reforms from other areas; (vi) reducing CO₂ emissions;
 - *Environment sector*: (i) promoting policy, legislation and institutional framework for the purpose of approximation to the sustainable environmental management, as a whole; (ii) cooperation with the environment sector in development projects, aiming to enhance environmental benefits; (iii) enhancing sensibility for water resources and climate changes; (iv) introduction of ideas of required ecological flow and ecosystem management in the water management sector; (v) promoting the idea of „strategic environmental assessment“ and introducing „upstream users“ in the decision making processes; (vi) promoting ecologically and socially sustainable development through private sector participation; (vii) primarily focusing on the local ecological benefits, with consideration of the broader ones.

²³¹Conclusions of the International Conference on Water and the Environment, Dublin, January 1992

²³²Reffrence text: World Bank Water Strategy, 2001.

4.3.4.2.4. Operational Objective 9: Establishment of Reference and Authorized Laboratory(-ies) for Water Quality Testing²³³

Article 64 of FBiH LoW defines the requirement of establishing a reference and authorized laboratories. According to this Law, the reference laboratory would, within its scope of activities, have several functions related to supervising the work of the authorized laboratories, as well as implementing the activities related to the water quality protection and generally, environment protection. Given the scope of duties envisaged for the reference laboratory, it is very likely that it will not be only one reference laboratory, but that several reference laboratories will be appointed.

Measures:

- Development of technical groundwork for adopting the by-law concerning the conditions and the scope of work of the reference laboratory(-ies) and the authorized laboratories;
- Appointing reference laboratory(-ies) for the territory of the Federation of BiH by FMAWMF;
- Appointing and licensing the authorized laboratories and cooperation with the inspection offices for the purpose of determining the pollution load.²³⁴

4.3.4.2.5. Operational objective 10: Improvement of alert system and efficient responding in cases of accidental water pollutions and water pollution emergencies

Measures:

- Development of a technical groundwork for the by-law describing the procedures and actions in case of accidental and emergency pollutions;
- Enhanced system of inspection over the water bodies where there are the changes that resulted from natural disasters or human negligence-caused disasters, in cooperation with associations of citizens (fishery associations, nature lovers, eco-associations, etc.).

4.3.5. Use of Waters

4.3.5.1. Introduction

According to the Law on Water²³⁵ *“Water must be used rationally and economically. Every water user shall use water in a manner and a scope preventing wastefulness and detrimental alterations of its properties (quality) while guaranteeing the legal right to water use to other persons.”* Sustainable use of water implies provision of sufficient volumes of water of suitable quality for the existing and development needs of all users, taking into account natural capacity (renewability) of the resources.

²³³ Law on Water of the FBiH, Article 64, Paragraph 1: The *reference laboratory* shall carry out the water status monitoring, verification of results of the work carried out by the authorized laboratories, the implementation of tasks within the competence of the Federal Ministry, the federal ministry in charge of the environment, the cantonal ministries in charge of water and the environment and the River Basin District Agency.

Article 64, Paragraph 3: Quality monitoring of wastewater and effluents from the wastewater treatment plants shall only be carried out by the authorized laboratory.

²³⁴ The Federal Ministry of Agriculture, Water Management and Forestry published (web site of the Ministry, July 2009) the List of Laboratories Authorized for Measuring Waste Water in the Federation of BiH: Institut za hemijsko inženjerstvo Tuzla; JKP Ljubuški, Ljubuški; KP Rad, Tešanj; Dvokut d.o.o. Sarajevo; Biotehnički fakultet Bihać; Herkon d.o.o. Mostar; AVP Sava, Sarajevo; Institut za hidrotehniku Sarajevo and Zagrebinspekt d.o.o. Mostar. The authorizations were given for a 2-year period.

²³⁵ Official Gazette of BiH Federation No. 70/06

According to the Law on Water of BiH Federation, structures for water use are:

- water supply system structures (other than those for general water use) – dams and reservoirs, water abstraction structures, wells, captures with relevant equipment, drinking water treatment plants, water tanks and pipelines and other associated structures;
- water supply structures for industry - dams and reservoirs, water abstraction structures, wells, captures with relevant equipment, pipelines and other associated structures;
- irrigation structures - dams and reservoirs, supply channels and tunnels, water abstraction structures, pumping stations, water gates, supply and distribution network and other associated structures;
- structures for use of water power - dams and reservoirs, water abstraction structures, supply and discharge structures and other associated structures;
- navigation structures – waterways, navigation locks, water gates and other associated structures and equipment;
- structures for other purposes – fish farming structures, recreational pools, lakes, etc.

The River Basin District Agency is responsible for: (i) issuing water deeds for water abstraction of quantities exceeding 10 l/s, (ii) construction of hydroelectric power plants for production of electrical energy when the plant is located on I category surface waters or on II category surface waters and has a capacity exceeding 5 MW, as well as two or more plants located on II category surface waters with the capacity exceeding 2 MW, and located at the distance of less than 2 kilometres from one another, as well as for (ii) construction of water reservoir located on I category surface waters or located on the territory of two or more Cantons. Cantonal ministries in charge of water are responsible for: (i) issuing water deeds for water abstraction of quantities not exceeding 10 litters per second, (ii) construction of hydroelectric power plants for production of electrical energy when the plant is located on II category surface waters with the capacity of up to 5 MW, as well as for (iii) construction of water reservoir located on II category surface waters and within the territory of the Canton concerned.

As regards defining the strategic objectives, the area of water use is generally considered from the two main aspects:

- use of water for the needs of public water supply, and
- use of water in areas whose development depends on market interest.

Strategic objectives under these main two aspects of water use are:

Strategic objective 6:	Increase in coverage and improvement of public water supply systems
Strategic objective 7:	Ensuring conditions for sustainable use of waters in the areas whose development depends on market interest

4.3.5.2. Strategic objective 6: Increase in coverage and improvement of public water supply system

Priority in water use is water supply for population what is a public interest of the society and one of the main tasks of water sector²³⁶. In the interest of improving the overall standard, maintenance and improvement of the health of population within the water management, the starting point

²³⁶ Article 47, paragraph 2 of the Law on Water of BiH Federation: "Water use for public drinking water supply, sanitary needs and fire protection needs shall be given priority over other water use purposes..."

primarily is the indicators of inhabitants' connection to the public water supply systems. Through previous chapters of examining the existing status in this area, it can be noticed that coverage by public water supply system is still relatively low in BiH Federation, the percentage of loss in water supply systems is high, total available volumens of water are sufficient but unevenly distributed as regards the users and quality of fresh water in certain areas fails to meet legal criteria of drinking water quality (what causes prior conditioning).

Overall development of the society conditions further development of public water supply systems. This also includes the demand on the part of economy which does not use its own water abstraction. Increase of coverage by public water supply systems can be achieved not only through construction of new systems but also through legalization and connecting the existing local water supply systems to public water supply systems. In this sense, it is necessary to create conditions for sustainability of public water supply systems through provision of sufficient volumes of water of the needed quality. On the other hand, important task for the purpose of achieving the set objective is to reduce water loss thus providing significant volumes of water and reducing needs for abstraction of additional water what is in line with the set principles of rationality. Examining the available water resources by quantity and quality, one of the objectives is undoubtedly additional research with the aim of securing new water resources or expansion of the existing primarily groundwater while focusing, if possible, on those whose protection is actually implementable. In addition to this, it is necessary to protect the existing water resources and align their protection with spatial development of urban areas.

4.3.5.3. Strategic objective 7: Ensuring conditions for sustainable use of waters in the areas whose development depends on market interest

Based on the conducted analyses of the current status, as well as the status in the period until 1991 and analyses on needed and available water volumes done at that time, it can be stated with certainty that the available water volume provides for the needs of all users to be met. It is only in extraordinary cases, in shorter water scarcity periods and depending on the quality of the individual systems, that it can come to limitation of access to water. Bearing in mind the status until 1991 when situation regarding development and use of water in this category was different (greater water demand, large losses, outdated technologies) it is to be expected that, by applying relevant legislation regulating this area, water will not serve as a limiting factor of development. Use of water in areas whose development depends on market implies the following industry branches:

Industry:

Despite unfavourable current status, positive developments can be noticed in development of industrial production. More intensive growth of food processing, pharmaceutical and processing industry can be expected, and those are mainly consumers of water of drinking water quality. Water sector can contribute to development of these industry branches by providing support to construction of utility infrastructure. Industry supplied with technological water from its own water abstraction structures, provided for use through concession, is in development phase. General development goals in this area, among other things, should be based on the principles of introduction of best available technologies that have influence on rationalization of water consumption, use of water from the existing water abstraction structures developed for such purposes and development of planning documents defining the strategic objectives of industrial development.

Agriculture and fishery:

In the previous period agriculture was mostly outside the global development trends what makes the obstacles to improvement, activation and catching up with the missed even greater. Through the “Medium-term Strategy of Development of Agricultural Sector in BiH Federation (2006-2010)” the following development scenario is preferred:

“Free market, with ensured development of agricultural sector and creation of environment in which agricultural production is a supported part of a much wider range of social interest than it is itself. These interests are reflected in production, cultural and ecological treatment of the area concerned, motivation of population to live in villages, etc. The State is present in all these interests and exercises its direct influence on the structure of agricultural production and its intensity. It implies moderate intensity which presents no threat to environment and in near future enables activation of most economically usable acreages. It also supports a wider organic (ecological) production. It leads to a balanced processed foodstuff balance of the entities and state as a whole.”

In this context, conclusions and requirements related to water sector have been specified, among which are the following:

- Introduce irrigation to lands which were previously regulated in the sense of protection against water, drainage, organization of production areas, etc;
- Reconstruction of the existing and planning of new areas suitable for irrigation;
- Reconstruction and upgrading of the existing hydro-melioration systems;
- Extending irrigation in areas which have available good-quality water resources.

According to the Law on Water²³⁷, Article 51: Land improvement systems, it is stated:

- A special legal entity may be established (cooperative, association, etc.) for the purpose of construction and/or use of a land improvement system for irrigation and/or drainage that is in the interest of several owners or land users.
- The legal entity referred to in paragraph 1 of this Article shall acquire the right to use of the water. The abovementioned implies that reconstruction and upgrading as well as further development of hydro-melioration systems themselves depends on the interest of land users while water sector has the interest in providing sufficient quantities of water of adequate quality for irrigation of agricultural areas, along with regulation of terms and conditions on coverage and manner of cultivation of acreage from the aspect of use of manure.

Within the foodstuff production, fishery in our country had no larger influence thus far. However, prerequisites for development of this industry branch exist primarily in the sense of water resources along with, of course, observance of conditions of *preservation of water quality*. Significant fish farming can be expected in natural and artificial reservoirs where it has to be harmonized with other water users. Also, potentials for sea fish and shellfish farming in Neum Bay have to be emphasized.

Energy:

Water power and the remaining hydro-potentials are strategically important for the State as it is its own, renewable and environmentally friendly source of energy. Storage hydroelectric power plants are also a very important factor in water management sector because multipurpose facilities of this type contribute to tackling a wide range of water management issues: water supply, irrigation,

²³⁷ Official Gazette of BiH Federation No. 70/06

water protection, etc. Energy Strategy announces increase in interest for construction of hydroelectric power plants. In multipurpose projects, which can be drivers of local and regional development, the interest of water sector is reflected in participating in implementation of those projects through which rational use of available water resources (multipurpose solutions) is provided as well as observance of water regime sustainability (ensuring environmentally friendly flows, improvement of small-scale waters, etc.).

Sport and recreation:

Stagnation in development of water sport and recreation is noticeable and caused by deterioration of water quality in particular during summer time due to minimal flow, high concentration of pollution, lack of bank maintenance, degree of urbanization, vicinity of roads, etc. On the other hand, requirements for providing conditions for mass use of rivers and lakes are growing. Tourism Development Strategy, currently being drafted, should primarily specify sites of interest for development of specific types of water sport and recreation while water sector activities should ensure adequate protection of quality at all watercourses²³⁸.

Navigation:

In the part related to the existing status of inland water transport, it can be seen that possibilities for this form of water use are very limited in BiH Federation. Certain activities can be planned in the sense of:

- expansion, regulation and maintenance of the existing waterways,
- planning of multipurpose reservoirs which would, in addition to other forms of water use (water supply, irrigation, flood protection, etc), enable increase in flow, reduction of spreading deposits and thus improve conditions for construction and extension of waterways.

Mineral, thermal and thermomineral waters:

Total water yield of these waters is 5,230 l/s out of which mineral waters have the largest water yield. Mineral, thermal and thermomineral waters of BiH Federation are found in numerous sites in a form of natural phenomena – sources and artificial structures – dug wells, boreholes and drilled wells. It is certain that a small degree of exploration is observed, thermomineral waters are of the highest degree of exploration while mineral waters are less explored. Bearing in mind the increasing interest for use of these waters, it is necessary to stimulate multipurpose use of geothermal waters, e.g. for medical purposes, tourism, recreation, etc. Use of mineral and geothermal waters should be aligned with *plans of research works and protection of these types of sources in order to secure their sustainability*. Use of water for markets is increasing and further development of this industry branch is expected. In this case as well it is necessary to *define plans of their use and protection*.

²³⁸ According to the Law on Water: “A *bathing area* is an area intended for public recreation on water (swimming etc.) and an area where bathing is not forbidden, being traditionally used for this purpose. The bathing area shall be designated by the municipal water authority. The bathing area shall be protected from pollution and other forms of use or any occurrence that could impact the quality of bathing water. Activities posing or likely to pose risks to health or lives of bathers shall be prohibited.”

4.3.5.4. Operational objectives and measures for the area of water use

Operational objectives for water use are presented in accordance to the areas: water supply of population and water supply in areas depending of economy interest.

4.3.5.5. Public water supply

4.3.5.5.1. Required water quantities

The approach to implementing the defined strategic objective of water use: *Increase of coverage and improvement of public water supply system*²³⁹, apart from assessment of the existing status, represents the assessment of water demand in the planned period. In addition to assessment of the existing status, a starting point for each planning is a careful assessment of future development based on realistic assumptions. From the aspect of water supply, this means to set realistic assumptions of coverage by public water supply system in Strategy's planned period (2020) for all areas as well as specific consumption in order to obtain as much as possible realistic indicators of water demands²⁴⁰.

Table 4.5.2 gives planned increase of coverage of population by individual river basin and sub-basin districts together with the aim of *increasing coverage by water supply system by approximately 20%* meaning that the existing percentage of connection of population to public water supply systems of 61% is envisaged to increase to 80% by the end of planned period. With the aim of achieving full coverage, extension of the existing water supply systems to bordering areas is primarily planned for municipal centres.

²³⁹ Under the Law on Water²³⁹: “Public water supply” means the activities of abstraction of ground or surface waters for the purpose of securing water supply for the population; of water treatment up to the health safety degree and of providing piped water supply to the consumption point and its distribution to water users, if the total abstracted volume of water exceeds 10m³ per day” what implies organized, controlled and institutional activities on supplying drinking water to population, institutions and economy.

²⁴⁰ A study titled “BiH Federation long-term programme for drinking water supply for population and economy in the Sava River Basin District” was used as a basis for assessment of water demand by population and economy, with adequate corrections related to the current number of inhabitants, and by processing the Adriatic River Basin District based on the same principles.

Federation of BiH – analysed area	Population			Coverage			Population – coverage ws		
	2007 ²⁴¹	2010	2020	2007	2010	2020	2007.	2010.	2020.
	population	population	population	%	%	%	population	population	population
Sava River Basin District									
Bosna sub-basin	1,356,678	1,418,678	1,606,328	0.64	0.74	0.83	865,004	1,056,124	1,328,169
Vrbaš sub-basin	96,283	100,683	114,001	0.50	0.64	0.76	48,565	64,343	86,119
Una, Glina and Korana sub-basins	299,487	313,174	354,597	0.65	0.73	0.82	194,800	229,888	289,813
Drina sub-basin	69,289	72,456	82,039	0.42	0.56	0.69	29,300	40,411	56,292
Immediate Sava river basin	126,594	132,379	149,889	0.33	0.44	0.71	42,231	58,268	93,923
Total	1,948,331	2,037,370	2,306,855	0.61	0.71	0.80	1,179,900	1,449,035	1,854,315
Adriatic River Basin District									
Neretva river basin with Trebišnjica	303,540	317,412	359,396	0.62	0.70	0.78	188,056	220,624	280,351
Krka and Cetina basin	70,460	73,680	83,426	0.34	0.47	0.64	23,610	34,439	53,057
Immediate Adriatic basin	6,028	6,303	7,137	0.50	0.61	0.72	3,000	3,823	5,104
Total	380,028	397,395	449,959	0.56	0.65	0.75	214,666	258,886	338,512
Grand total for FBiH	2,328,359	2,434,765	2,756,814	0.60	0.70	0.80	1,394,566	1,707,921	2,192,827

Table 4.3.5.1: Plan for increasing the coverage of population with public water supply system

Assessment of the necessary quantities of water of drinking water quality for the territory of BiH Federation in Strategy's planned period, based on the expected demographic development and assessed elements of consumption, is given in Table 4.5.3.²⁴²

Federation of BiH – Analysed area	Water demand expressed as maximum daily consumption (maxQday)					
	2007		2010		2020	
	m ³ /d	l/s	m ³ /d	l/s	m ³ /d	l/s
Sava River Basin District						
Bosna Sub-basin	397,109	4,596.2	492,842	5,704.2	612,585	7,090.1
Vrbaš Sub-basin	20,600	238.4	28,331	327.9	37,652	435.8
Una, Glina and Korana Sub-basins	82,104	950.3	134,953	1,161.1	126,276	1,773.2
Drina Sub-basin	12,407	143.6	17,682	204.7	24,498	283.5
Immediate Sava river basin	177,86	205.9	25,296	292.8	40,627	470.2
Total	530,006	6,134.3	699,104	7,690.6	841,638	10,052.9
Adriatic River Basin District						
Neretva river basin with Trebišnjica	74,270	859.6	91,458	1,058.5	116,572	1,349.2
Krka and Cetina basin	30,067	348.0	14,978	173.4	22,960	265.7
Immediate Adriatic basin	18,857	218.3	1,529	17.7	1,931	22.3
Total	123,194	1,425.9	107,966	1,249.6	141,463	1,637.3
Grand total for FBiH	653,200	7,560.2	807,070	8,940.2	983,100	11,690.2

Table No.4.3.5.2: Assessment of the needed quantities of water for inhabitants, area of BiH Federation

²⁴¹ Number of inhabitants for 2007 is given based on data/assessments of the Federal Office of Statistics Sarajevo. With regards to organization of public utility companies, number of inhabitants by river basin and sub-basin districts is given taking into account total population of municipality concerned regardless of the fact that certain number of settlements gravitates to the neighbouring river basin – sub-basin district. Thus, a difference can be noticed when compared with tables 1.1.3, 1.1.4, 3.4.1 and 3.4.2.

²⁴² Needed quantities of water for areas whose development depends on economic growth and even on market interest are not explicitly given in the Water Management Strategy. The role of water sector is, in fact, not to assess necessary water quantities for these purposes as well (these are data given by specific sectoral strategies of agriculture, energy, industry, mining, etc.) but, through cooperation with the listed sectors, to determine terms and conditions regarding the manner of use and discharge of used water.

4.3.5.5.2. Overview of available water resources for public water supply

Availability of water resources is determined by two main factors: quantity and quality of water. These factors also influence the order of use of water resources, when considered for the purpose of meeting the water supply demands, primarily groundwater and then surface water.

Groundwater (total, intergranular aquifer – 3.71 m³/s and Karst-fissure aquifer – 33.37 m³/s) are usually the high-quality waters in nature, especially those from intergranular areas. They are characterized by capability of autopurification and, having in mind very low pace of infiltration, they are relatively insensate to external pollution or at least give enough time for implementation of protective measures. Other type of groundwater, from Karst-fissure areas, by its spread and quantities, has an important place among potential sources. Thus far findings state that these are usually water resources with small autopurification capabilities, as well as periodic and very high organic and suspended pollution.

Potential water resources of surface waters are: watercourses (natural or artificial), natural lakes and artificial reservoirs (total, own water – 670 m³/s, as average annual flow). These sources are characterized by variable quality, from case to case, depending on the level of pollution they are exposed to. Water quality ranges from very good, almost completely unaffected by adverse effect of urbanization and intensive agricultural production, to some cases of completely deteriorated quality.

Groundwater from watercourse alluvium are mostly either already exposed to pollution or used for the needs of water supply. As for abstraction of additional quantities, it is possible to either perform abstraction of surface water, with treatment, or forming reservoirs in the river upper courses. Of course, selection of water source for each municipal centre has to be considered separately together with carrying out technical and economic analysis. In general, when selecting a water resource the following order is used:

- *Groundwater*; (1) maintaining the existing sources; (2) increasing capacity of the existing with new water abstraction facilities; (3) activation of new sources of groundwater;
- *Surface water*; (1) artificial improvement of capacity of groundwater; (2) open water abstraction structures from natural lakes, existing artificial reservoirs or watercourses;
- *Artificial reservoir*, depending on circumstances, planned mainly in upper parts of watercourses;

Based on the aforesaid, the following conclusions may be drawn:

- Total necessary quantity of water supply for population and industry by individual river basin district does not exceed capacities of potential sources. The same situation is throughout the area of BiH Federation. In other words, there is sufficient water for meeting the demands of public water supply in the planned period.
- Distribution of water sources and their relation to sites of consumers, i.e. consumers' orientation towards individual water sources, is subject of special analysis which should be carried out in the next phase of development of Management Plans.
- Total groundwater capacities, i.e. water from intergranular and Karst-fissure areas, fully meets the demand in the planned period. This, of course, does not mean that there is no need for open water abstraction structures or storage lakes what is conditioned by spatial disproportion of consumption area and groundwater sources, however, it also indicates the abundance of this water resource and the need for its preservation and quality protection as well as further research.

- Singled out as the most interesting river sub-basin district, with the largest total demand, is Bosna river sub-basin district. The relation between necessity and availability is most favourable in this river sub-basin district. According to the current and taking into account the demand in planned period, total capacities of groundwater, estimated to approximately 7.16 m³/s, are extensively used. Quality of surface water is to a great extent deteriorated and necessity of forming multipurpose reservoirs with water supply as their priority purpose is expected solely in this river sub-basin district;
- Characteristic of Drina river basin district is scarcity in groundwater capacities what largely complicates the attempts to tackle the issue of water supply, i.e. indicates the need for forming open water abstraction structures with necessary treatment;
- Characteristic of Krka and Cetina river basin district is typical for Karst areas with very uneven distribution of settlements and water resources. Exceptional by quantity and quality, water resources of this area are at the same time both very demanding and complicated in relation to their preservation and protection. In addition to this, consumption area is quite scattered, thus investments into water infrastructure will be larger than anywhere else;
- Much attention in the forthcoming period has to be paid to activities on reducing losses. According to the analysis by individual municipalities, average reduction of losses by 16% at the level of BiH Federation would generate additional water quantities of 24,159,166 m³/year which should not be sought in new water resources.

Based on the background information and defined strategic objectives, operational objectives for the area of water use are the following:

Operational objective 11:	Increase in coverage by public water supply systems from the current 60% to approximately 80% by the end of Strategy planning period
Operational objective 12:	Reduction of loss in public water supply systems by approximately 15%
Operational objective 13:	Rational use, protection, improvement of the status and preservation of water resources being used or intended to be used for public water supply needs
Operational objective 14:	Preservation of water resources in accordance with terms and conditions of use and protection stipulated in the Law on Water of FBiH in line with the expected water demand in the areas whose development depends on market interest and overall economic progress

4.3.5.5.3. Operational objective 11: Increase in coverage by public water supply systems for the current 60% to approximately 80% by the end of Strategy planning period

Measures:

- Connecting local water supply systems to public water supply systems and their placing under full control (all other types of water supply – wells, tanks, and similar, should be progressively put under control primarily for the purpose of water quality control what additionally increases general level of population's health safety).
- Extension of coverage of public water supply system towards the peripheral areas;
- Establishment of group (inter-municipality and regional) water supply systems. Grouping users, i.e. water supply systems of municipal centres, is a process that has already commenced in some parts of Bosnia and Herzegovina. Forming group water supply systems has its justification: central control; security and reliability of its functioning; easier maintenance, etc. what implies commitment to proceed with establishment of such water supply systems in all cases that allow

and justify it. These processes are never fully predictable since there can be cases of decision-making regarding group water supply systems which are not based solely on technical settings.²⁴³

4.3.5.5.4. Operational objective 12: Reduction of loss²⁴⁴ in public water supply systems by approximately 15%

During processing data of utility companies responsible for water supply, losses were registered which represent difference between quantity of water abstracted and quantity of water billed. In addition to this type of loss, there are also losses regarding payment of billed water which are very difficult to be assessment and range from 10% to 20% of the total invoiced quantities. Reducing losses by around 15% could generate additional water quantities and reduce needs for over-abstraction of water from the existing resources or establishing new ones what contributes to rationalization of the use of water resources in the light of sustainable water use. Measures for achieving this operational objective (bearing in mind definition and causes of losses) include technical and institutional activities²⁴⁵ directed to improving the status of water supply facilities, increase amount of metered water inside the system and at the consuming points, institutional strengthening of utility companies for the purpose of efficient management, increase in the degree of collection and elimination of illegal connections as well as organizational and educational activities focused on informing population and raising public awareness on the importance and value of drinking water.

Measures:

- Replacement of worn out pipes and rehabilitation of worn out facilities in water supply systems²⁴⁶;
- Education of population and industry using drinking water on the need for rationalization of water consumption²⁴⁷;

²⁴³ It is evident that in the period ahead of us, a need for establishing group, intermunicipal and regional water supply systems has to be considered seriously. Today, pre-war plans for implementation of a wide regionalisation in the area of water supply systems cannot be considered any longer. Bearing in mind political situation in the country after the war, certain municipalities, and especially regions, have many difficulties as regards mutual cooperation regarding this issue. Of course, reasons also lay in the lack of funding for large-scale infrastructural projects. Good example for this is the area of Livno Valley which has quality water resources; however, pipelines to the place of consumption require large funding for a relatively small number of inhabitants. We can find most of reasons in this as to why previous plan of connecting Tomislavgrad and Glamoc in the system are not considered at this moment. Also, plans for resolving the issue of water supply for Tuzla region by conveyance of water from other sub-basins exist for couple of years now but it is difficult to expect that they will be implemented any time soon. What can be said for sure is that the needs for resolving the issue of water supply will stimulate the regions to find a common solution while accurate guidelines in this respect will be provided through management plans.

²⁴⁴ The term "losses in public water supply systems" used here implies losses incurred from the site of water abstraction to household water meter and also the so-called unbilled unmetered consumption, i.e. difference between water quantities supplied to public water supply systems and paid quantities, based on public water supply services. In other words, the term "loses" does not imply only losses due to technical malfunctioning of the distribution network.

²⁴⁵ Measure: Institutional and professional strengthening of utility companies as regards the area of water supply system and sanitation, within achieving the Operational objective 6.

²⁴⁶ Worn out pipelines still largely exist in the older water supply systems, especially in urban areas, and are categorised by high level of losses and unfavourable impact on health of population; thus, they need to be prioritised and changed with adequate piping material. It is also necessary to continue the process of rehabilitation and reconstruction of worn out and damages structures of water supply systems from water abstraction structures, pump stations and reservoirs to distribution network which are still many.

²⁴⁷ Another inevitable factor is continuous work on informing, education of population and raising public awareness on the need of water saving through school activities and not only through lectures but also through practical workshops (designing posters, comic books, videos, etc.), competitions for the best design, etc. Education of business entities

4.3.5.5.5. Operational objective 13: Rational use, protection, improvement of the status and preservation of water resources being used or intended to be used for public water supply needs

Given that groundwater will be mostly used for the needs of water supply system in Strategy's planed period, necessary measures for implementing this operational objective are:

- Continuous implementation of research works on the existing and potential water resources from the aspect of their use for water supply needs.

When selecting potential drinking water sources, a need for maximum possible use of the existing waters should be stressed, and as regards selection of the new water sources, the prioritization is as follows:

- (a) *Groundwater* (alluvial waterbearing layers, Karst-fissure areas);
Use of groundwater from intergranulated areas of watercourse alluvium is primarily recommended, especially those which are not endangered by lasting pollution either from the watercourse itself or from the banks. In most cases, these are existing water sources whose extension is planned. In many cases, in northern parts of BiH Federation, there is a need for water treatment mostly due to the increased contents of iron, manage and nitrogen compounds. Sources of groundwater from Karts-fissure areas are very abundant sources especially in Northwest and Southwest parts of the territory of BiH Federation and require particular attention in terms of protection planning.
- (b) *surface water* (rivers and natural lakes);
Watercourses, i.e. natural lakes are the only option for many consumption centres after the use up of previously mentioned resources. This solution is, of course, additionally complicated by the necessary equipment for treating water for drinking purposes;
- (c) *storage lakes* – is the last but in some cases inevitable option. In some cases, it is necessary to establish reservoirs with water supply as their primary purpose. For some areas such solution, though very costly, is at the same time the only one which in long-run resolves the issues of water supply.

- Implementation of technical and administrative measures of protection of sources in accordance with the Law on Water of BiH Federation.

It is no coincidence that the issues of protection of waters sources are constantly mentioned and emphasized. It is certainly the only reliable way to preserve the available water resources primarily in quantitative aspect. Failure to implement measures of protection can lead to serious stagnation of water quality what then brings along the need for their conditioning and significantly increases the water price and can also lead to long-term deterioration of freshwater quality and even abandoning the water source.

regarding introduction of environmentally friendly technological solutions in production processes, what, among other things, involves maximum use of water in recirculation, will significantly contribute to reducing consumption.

4.3.5.6. Operational objectives for use of water in areas whose development depends on market

In general, operational objective for this type of water use is:

4.3.5.6.1. Operational objective 14: Preservation of water resources in accordance with the terms and conditions of use and protection stipulated in the Law on Water of FBiH in line with the expected water demand in the areas whose development depends on market interest and overall economic progress

Regarding this form of water use, the interest from the aspect of water sector is achieving the objective to preserve water resources in terms of quantity and quality as well as to ensure strict implementation of the Law on Water which (along with the relevant by-laws) precisely sets out the procedure and terms and conditions of obtaining the right to water use. In this segment, it is necessary to stress the need for cooperation of water sector with all other sectors of economy, i.e. the need for participation of water sector in all plans and activities related to water use. In order to achieve the mentioned operational objective, the following measures have been planned, by forms of water use:

4.3.5.6.1.1. Industry

Measures:

- Incite application of more favourable technological processes in production which provide considerable water saving,
- Providing guidelines in development of industry growth plans from the aspect of water management.

As there are no precise development plans for some industrial branches, the prerequisite for monitoring the development from the aspect of water sector is their drafting and adoption in order to timely adopt decisions and recommendations. The term *industry* here implies the industry which does not use water of drinking water quality in its technological process. Such facilities usually meet their water demands through their own facilities. Usually, this is the water used for cooling or washing and most of the industries use recycling systems. According to the Medium-term Development Strategy for the period 2004 -2007, which derived from the Poverty Reduction Strategy Papers, the following were identified as strategic industry branches: wood processing, food processing, textile, metalworking, leather and shoe industry, tourism, energy, information and communication technologies.

Also, in 2007, Government of the BiH Federation adopted a decision on drafting the *Industry Policy and Industry Development Strategy* in preparation of which representatives of federal ministries of energy, mining and industry, ministries of transport and communications, agriculture, water management and forestry, trade and development, entrepreneurship and crafts should participate. "Strategic Plan and Programme of Energy Sector Development in BiH Federation" lists energy facilities which are planned for construction in the planning period until 2020 and which, from the aspect of water use for their own water abstraction structures, fall under the largest users – thermal power plant.

No.	Name of the facility	Number of aggregates of power (MW)	Installed power (MW)	Annual production (MWh)	Planned year of construction
1	TE Tuzla, block 7	1x370	370	2,047,000	2013
2	TE Kakanj, block 8	1x250	250	1,260,000	2013
3	TE Bugojno 1	1x300	300	1,630,000	2013
4	TE Kongora	2x275	550	3,000,000	2013
5	TE Tuzla B-1; Banovici 1	1x500	500	2,640,000	2017
6	TE Kakanj A combined c.	1x100	100	518,000	2017
7	TE Bugojno 2	1x300	300	1,630,000	2017
8	TE Kamengrad 1	1x215	215	1,190,000	2017

Table 4.3.5.7: Planned energy facilities for BiH Federation – thermal power plants

The status of domestic industry implies that Bosnia and Herzegovina cannot be developed on the same basis as in the previous period but rather that development concept has to be fundamentally changed. In the forthcoming period, use of BAT ²⁴⁸, recycling process, full observance of legislative with regards to paying water charges, as well as new market conditions will significantly contribute to reducing total water consumption for this purpose.

4.3.5.6.1.2. Energy – use of water power

Measures:

- Participation in development of plans for construction of hydro-electric power facilities under the conditions set in accordance with the River Basin District Management Plans, and
- Ensuring participation of water sector in development of studies on the exploitability of water power.

“Strategic Plan and Programme of Energy Sector Development in BiH Federation” attributes great significance to hydro-energy as renewable and environmentally friendly energy source. Energy sector plans, based on which the future development is envisaged, give several hydroelectric power plants as possible candidates for construction in Strategy’s planned period until 2020. Total hydro-potentials available for energy use is considerable, while less than 40% of the available was used to date. The given planned period considered construction of new production hydro-capacities of 442.5 MW of total installed power, i.e. 1281.68 GWh of annual production. Facilities planed until now, according to data from the two electric-power supply companies in BiH Federation, are given in the table below:

²⁴⁸ BAT – Best Available Technology

No.	Name of facility	Number of aggregates of power (MW)	Installed power (MW)	Annual production (GWh/year)
1	HE Mostarsko blato	2x30	60	167
2	RHE Vrilo	1x52	52	92
3	RHE Kabić	1x52	52	73
4	HE Glavatičevo	171.8	171.8	295
5	HE Bjelimići	2x50	100	306.4
6	HE Ustikolina	1x59	59	255
7	HE Vranduk	1x22	22	103.2
8	HE Unac	2x35.5	71	250
9	HE Han Skela	1x8.5	8.5	36
10	HE Ugar Ušće	2x5.8	11.6	33.18
11	HE Ivik	2x5.6	11.2	22.07
12	HE Vrletna kosa	2x5.6	11.2	22.53
13	HE Vrletna Kosa	2x12.5	25	63
14	HE Vrhpolje (with HE Čaplje)	1x68+1x7.7	68+7.7	157.4+56.8

Table 4.3.5.8: Overview of planned production capacities in BiH Federation²⁴⁹

Out of the given hydro-energy capacities, *Elektroprivreda BiH*²⁵⁰ highlights the following as its priorities: HE Unac, HE Ustikolina and HE Vranduk. (Out of these, realization of HE Unac is already uncertain due to designation of Una River Basin District protected area and limitations arising from this.) On the other side, the Commission established by the Government of BiH Federation supported the implementation plan for Glavatičevo and Bjelimići hydro-energy facilities.

Elektroprivreda HZ HB states²⁵¹ that the realisation of hydroelectric power plant Mostarsko Blato is certain for which the entire procedure is finished and whose construction should begin in 2009.²⁵²

It has to be stressed that hydro-energy facilities alter the water regime and have significant environmental impact, thus, multi-criteria analysis has to be developed for each facility, in accordance with the legislation, which will elaborate and present to all stakeholders all positive and negative effects.

“Strategic Plan and Programme of Energy Sector Development in BiH Federation” states that small hydroelectric power plants, apart from biomass, currently represent the most important SES²⁵³ in BiH/Federation of BiH and their development should be a priority when defining sectoral policies and strategies for energy sector. There are various assessments regarding the potential of small-scale hydroelectric power plants among which there are no significant discrepancies. Adequate

²⁴⁹ The table gives hydro-energy production data planned until July 2009. It is possible that during the following phases of development of planned documentation they will be modified and adjusted.

²⁵⁰ Public enterprise *Elektroprivreda Bosne i Hercegovine d.d. Sarajevo*

²⁵¹ Public enterprise *Elektroprivreda hrvatske zajednice Herceg Bosne d.d. Mostar*

²⁵² Also, *Elektroprivreda HZ HB* is to a great extent actively involved in water regime management system and as such, has commissioned development of numerous studies out of which the following ones should be emphasized: “Basis for Water Management Conditions for Hydro-energy Facilities in Tihaljina-Mlade-Trebizat River Basin District, Listica River Basin District, and Gornja Cetina River Basin District” and “Strategic Assessment of Environmental Impact on T-M-T and Gornja Cetina River Basin Districts”.

²⁵³ Sustainable energy source

potential for construction of small hydroelectric power plants in BiH is 1,004.63 MW or 3,519.74 GWh. Out of this, approximately 2,090 GWh is available in BiH Federation and 1,430 GWh in Republic of Srpska. Also, a study was developed for around 160 small hydroelectric power plant sites and foreseen capacities of these plants are 122 MW, i.e. 552 GWh of produced energy annually. Water sector will, through enforcement of water management policy, serve as a support to development of energy and use of hydro-potentials with certain prerequisites. This primarily implies environmental acceptability of projects what will inevitably require bigger costs (e.g. achieving environmentally acceptable, guaranteed flow rate, as well as implementation of measures for protection and improvement of water quality, etc.).

4.3.5.6.1.3. Agriculture

Measure:

- Ensuring participation of water sector in development of agricultural land irrigation study for the territory of FBiH.

Having in mind the large deficit in foodstuff production and development trends laid down in the *Medium-term Agricultural Sector Development Strategy for BiH Federation (2006-2010)*, it is obvious that significant changes are to be expected in agricultural sector. Set strategic objectives of competitive agricultural production require improvement of status of hydro-melioration systems. The fact is that this area is completely neglected in our country and thus, there are no irrigation plans. In this sense, one of the development priorities is to put a stop to further deterioration of the existing systems and their bringing to operational readiness in line with the new terms and conditions and needs. The other problem having large influence on the work of hydro-melioration systems is fragmentation of agricultural land what relevant institutions need to resolve as their priority. One of the main prerequisites for development of irrigation systems in potential areas (approximately 80,800 ha) is provision of necessary water quantities of adequate quality.

There is a problem regarding provision of irrigation water as it has to be provided in critical summer period when water levels are lower due to unfavourable layout of precipitation and large consumption. Minimum daily outflow is sometimes up to 85% less than multiannual average outflow. In addition to watercourses, irrigation water should also be used from reservoirs and groundwater reserves.

According to the assessment, gross irrigation water demand (including losses) is averagely 3,000-3,500 m³/ha annually for the Sava River Basin District. For the time being, there is no reservoir that could be used for irrigation in this area and water quality is an issue. It is recommended to examine the possibilities for transforming the existing hydro-energy facilities into multipurpose ones and plan for new multipurpose systems which would provide sufficient quantities of irrigation water as support to agricultural production.

According to the assessment, gross irrigation water demand (with losses) is averagely 4,000-5,000 m³/ha annually for the Adriatic River Basin District. Available quantities of water during the summer period in this area are usually insufficient with the exception of Neretva valley. It is recommended to use technologies and equipment for irrigation that spend minimum water in these areas.

It is also necessary to emphasize the need of close cooperation and activities of water and agricultural sector in the interest of improving agricultural production. Based on the above given

data, it is estimated that large success would be achieved if the present 0.2 percentages of irrigated area could be increased to achieve the pre-war level of 1.8% of irrigated arable lands.

4.3.5.6.1.4. Navigation

Measure:

- Ensuring water sector participation in activities on reconstruction and restoration of the existing waterways and inclusion of navigation aspect in multipurpose reservoir development plans.

Navigation on rivers, which has ceased in the past period, is one of the branches that should be developed in the forthcoming period. It is assumed that normalization of situation in the region and increased cooperation with neighbouring countries will lead to greater use of river waterways. In BiH Federation, in addition to a small section on Sava river, possibilities of navigation development exist mostly on confluences of I category rivers. This mostly implies maintenance and extension of the existing waterways (lower course of Neretva River). Waterways can be extended to middle courses with the prerequisite of use of the existing and planned reservoirs, which serve for other purposes as well, as multipurpose facilities. Rules of preservation of water quality are applied for waterways as well and this includes certain restrictions and prohibitions regarding the use of petroleum products. Regulation and maintenance of waterway on Sava River cannot be considered only within the BiH Federation but within the entire BiH as well and in accordance with the interstate agreement which legally regulates navigation on Sava River.

Reservoirs used for the purpose of water supply – Modrac, are subject to strict restrictions regarding their use for the purpose of navigation.

4.3.5.6.1.5. Fishery

Measures:

- Ensuring water sector participation in preparation of fishery development plans in terms of warmwater and coldwater fish farms as well as development of fish cage farming.

In BiH Federation there are possibilities for fish farming in natural environment, flowing waters and lakes, i.e. reservoirs, meaning that presently water and land availability are not a limiting factor to development of this industry branch. The Sava River Basin District has all prerequisites for development of warmwater and coldwater fish farms. The Adriatic River Basin District has all prerequisites in place for development of coldwater fish farms and fish cage farming in artificial reservoirs of greater depths. Development of river and lake fishing, from technological point of view, can be divided into two main directions:

- Farming for the purpose of populating watercourses, natural lakes and reservoirs, for the purpose of controlled increase of fish population in the mentioned water biotopes along with securing water quality monitoring, and
- Farming exclusively for the purpose of supplying markets with high quality fish meat with the accompanying processing.

Sea production is limited by the size of sea area of Neum Bay. Regarding reservoirs, development of this branch has to be aligned with other water users. Reservoirs planned to be constructed for the

purpose of water supply are not favourable for fish farming because of the possibility of water quality deterioration on one side, and on the other, differences between the reservoir use plan and technology used for fish production.

Competent agencies provide terms and conditions for establishment and operations of fish farms in each concrete case both regarding abstraction of necessary water quantities and water discharge.

4.3.5.6.1.6. Water sport and recreation

Measures:

- Identification of sites favourable for development of water sports and recreation;
- Including the aspect of sport and recreation in plans on construction of multipurpose reservoirs;

When conducting analysis of potential sites for development of recreational water zones, in addition to qualitative characteristics of water, it is also important to know hydrological regime and, in line with it, give architectural and technical design for arrangement of banks and recreational area, bearing in mind achieving a simple communication with water as well as that the areas are not threatened by high waters. The plans should foresee the following:

- Identification of possible sites of relevant potential for which the interest is expressed as regards development of certain types of water recreation;
- Assessment of possibilities of providing environmentally acceptable flow on all watercourses and especially in those sections where construction and arrangement of sport fields is planned;
- Inciting activities aimed at improving water quality in watercourses through introduction of measures of water quality protection and intensifying construction of facilities for waste water treatment the final objective of which is bringing the watercourse to a prescribed category;
- Ensuring increase of minimum flow in watercourses through construction of multipurpose reservoirs with arranged areas which can be used for recreational purposes and for improvement of water regime downstream from the barriers (stable tributaries, dilution of waste waters, etc.);
- Establishing monitoring and system of information on the quality of water for bathing in accordance with Directive 2006/7/EC of the European Parliament and Council dated 15 February 2006.
- Arrangement of area, i.e. part of the river banks in the zone where recreational activities are foreseen with design solution for infrastructural facilities.

4.3.5.6.1.7. Mineral and geothermal waters

Measures:

- Continued implementation of research works together with development of plans on long-term use of these waters, with emphasize on multipurpose use, and
- Development of plans on implementation of measures of protection of these waters;

Based on the summary of present water use as well as data on the large number of water finding sites which are not used, it can be concluded that there are possibilities for expanding the range of use on the sites currently exploited as well as on those which have not been used thus far.

4.3.6. Water quality protection

4.3.6.1. Introduction

It is stated in item titled “Starting Points in Defining Water Management Objectives” that the quality of surface waters is threatened and at certain sites even undermined while the situation is, as expected, the poorest in watercourses of Bosna River Basin District. Given as the major causative agents of pollution are urban waste waters produced by inhabitants and the industry. It is also stated under the same item that, based on insufficient data, as well as on the basis of understanding the degree of potential anthropogenic impact in recharging zones, it can be concluded that, generally, the quality of groundwater is still mainly good, i.e. sufficiently good for the main purpose of groundwater – supply of drinking water. Observed trend of deterioration of the quality of surface water²⁵⁴, in the period until 1991, has been stopped due to obvious reasons and shows certain improvement of not the same intensity on all controlled watercourses.

Strategic objective of water quality protection arises from the Law on Water of BiH Federation²⁵⁵, which, under the item “Objectives of Water Management”, among other things, reads: *Achievement of good status or good ecological potential of surface and ground waters*²⁵⁶.

Furthermore, in EU Water Framework Directive (WFD), the purpose is given in Article 1. *The purpose of this Directive is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater.* Regarding surface waters, Article 4 “Environmental Objectives” of this Directive, among other things, reads: *Member States shall implement the necessary measures to prevent deterioration of the status of all bodies of surface water and Member States shall implement the measures necessary to prevent or limit the input of pollutants into groundwater and to prevent the deterioration of the status of all bodies of groundwater.*

Strategic objectives of water quality protection are also based on the requirements of use of trans-boundary watercourses defined by Helsinki Convention²⁵⁷ where it is stated under “Guidelines for developing water quality objectives and criteria”: (i) taking into account the aim of maintaining and, where necessary, improving the existing water quality; (II) aimed at reduction of average pollution loads (in particular hazardous substances); (iii) taking into account specific water-quality requirements (raw water for drinking-water purposes, irrigation, etc.); (iv) taking into account specific requirements regarding sensitive and specially protected waters and their environment (e.g. lakes and groundwater sources); (v) be based on the application of ecological classification methods and chemical indices for the medium- and long-term review of water-quality maintenance and improvement.

²⁵⁴ Surface water: all inland waters, except groundwater; transitional waters and coastal waters, except coastal waters belonging to territorial waters.

²⁵⁵ Article 22. Water Management Objectives.

²⁵⁶ *Surface water status*: means the status of a body of surface water, determined by the poorer of its ecological status and its chemical status.

Ecological status: means the quality of the structure and functioning of surface water ecosystems.

Groundwater status: means the status of a body of groundwater determined by the poorer of its quantitative status and its chemical status, Article 4 of the Law on Water of BiH Federation,

Good ecological potential: status of a heavily modified or an artificial body of water, so classified in accordance with the provisions of WFD.

²⁵⁷ Convention on Protection and Use of Trans-boundary Watercourses and International Lakes (Helsinki, 1992, BiH is not a signatory yet)

Based on the starting points given, the following strategic objectives have been defined for the area of water quality protection:

Strategic objective 8:	Achieving and maintaining good status of surface water and groundwater for the purpose of protection of aquatic flora and fauna and needs of water users.
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4.3.6.2. Strategic objective 8: Achieving and maintaining good status of surface water and groundwater for the purpose of protection of aquatic flora and fauna and needs of water users

For those waters whose quality and usage value have already been undermined it is necessary to eliminate the causes which led to this status and facilitate the process of recovery of water status as well as improvement of flow regime; as for waters of satisfactory quality, it is necessary to create conditions for such status to be preserved through integrated prevention and control of pollution. This is especially applied to waters which are being used or are planned to be used for drinking purposes²⁵⁸ and is also very important for those waters which have other purpose, and, accordingly, the usage value, as well as for those which are important for survival of aquatic flora and fauna.

One of the principles of the approach to water quality protection is limitation and control of introduction of physical and chemical, and bacteriological pollution in waste water collectors and, thus, creating conditions for improving the status of water quality. The next principle is monitoring and control of values of certain parameters in the recipient and maintenance of water quality in desired and previously stipulated limits. Combined approach to the issue of water quality protection implies, under Article 10 of the Water Framework Directive (WFD)²⁵⁹, to implement permanent control of water quality status on certain watercourse profiles while undertaking all measures to provide this in order to satisfy the criteria of use value of water and, at the same time, to implement the principle of maximum permitted values at the point of discharge of waste water. The criterion which will require stricter result will be considered relevant for a concrete case and will be applied as such. In order to operationalise and facilitate implementation of control and management of water pollution, it is necessary to prescribe, observe and control the limit values of certain qualitative parameters which must not be exceeded in a given timeline, with regular monitoring of water quality status in the recipient.

Application of proper technologies for purification treatment of waste waters produced by inhabitants and industry, as well as introduction of clean technologies in the production process reduce potential pollution being introduced into the recipients, thus creating some of the prerequisites for maintaining good water status. In the area of nonpoint sources of pollution, it is necessary to introduce best practices of land use in agriculture and forestry sector as well as measures against erosion and thus reduce sources of this kind of pollution. Part of nonpoint pollution originates from rural population, traffic and leachate water from regulated and unregulated solid waste landfills and other sources, thus, alteration to the water quality can be influenced through prevention and control of pollution originating from these sources.

²⁵⁸ Directive on quality of drinking water 98/83/EEZ dated 3 November 1998

²⁵⁹ Directive 2000/60/EC

4.3.6.3. Operational objectives and measures for the area of water quality protection

Operational objectives related to water quality protection can be quantified and valorised in the function of time and scope of application of prescribed measures through identification of changes in indicators of quality status of waters being protected. Indicators are measurable, and clear relations between the implementation of measures and impact on water quality alteration can be obtained through systematic monitoring.

One part of watercourses on the territory of BiH Federation has inter-state character and, regardless of the location of the confluence of inter-state watercourses in the sense of entity borders, the responsibility of water sector managing structures in BiH Federation is to fully observe the agreements signed with other states, accepted conventions and conclusions of international conferences²⁶⁰. In the area of BiH Federation, territorially belonging to the Adriatic River Basin District, there are watercourses which pass the interstate border and are significant for both BiH and Republic of Croatia and it is in the mutual interest of both states to prevent deteriorations and achieve good quality of water of these watercourses²⁶¹.

As it can be seen from the chapter on water use, the existing systems of public water supply are largely based on the use of groundwater, hence, special attention should be paid to this type of waters with the aim of preventing and limiting introduction of substances which in terms of deterioration of chemical characteristics can degrade these resources. In this sense, Directive 80/68/EEC dated 17 December 1979 was adopted, containing the list of substances whose introduction is prohibited, while Directive 2006/118/EC stipulates in more details the quality standards and manner of determining trends of water quality alteration, in accordance with Article 17 of FWD and its Annex 5.

By enacting by-laws²⁶², the prerequisites were created to introduce in practice the principles of controlled emission as well as the principle of reducing pollution at the place of its origin through certain restrictive and simulative measures. These by-laws refer to the quality of emission but do not take into account the status of water quality in the recipient what is, in the combined approach recommended in WFD²⁶³, taken into account in the document regulating this area in Republic of Srpska²⁶⁴. In addition to these by-laws related to waste waters, a Rulebook on Amendments to the Rulebook on Forms, Manner and Scope of Measuring and Testing Used Water, Discharged Waste Water and Materials Extracted from Watercourse was adopted – (Official Gazette of FBiH No. 20 dated 14 May 2003).

²⁶⁰ Danube River Protection Convention (Danube Convention), Framework Agreement on the Sava River Basin, Contract on Regulating Water Management Relations with Republic of Croatia, Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention)

²⁶¹ Contract on Regulating Water Management Relations with Republic of Croatia, Convention for the Protection of the Mediterranean Sea against Pollution (Barcelona Convention)

²⁶² Rulebook on limit values of dangerous and hazardous substances for technological waste waters before their discharge into public sewerage system, i.e. other recipient and Rulebook on limit values of dangerous and hazardous substances for waters which are after treatment discharged from the public sewerage system into a natural recipient, Official Gazette of FBiH, No. 50 dated 25 July 2007 adopted based on Article 124, paragraph 1, item 1 of LOW, Official Gazette of FBiH, No. 18/98; Decision on dangerous and hazardous substances in water, Official Gazette of FBiH, No. 43 dated 20 June 2007, based on Article 121, paragraph 4 of the Law on Water of FBiH, Official Gazette of FBiH, No. 18/9

²⁶³ Environmental quality standard for bodies of water together with stipulated emission limit values,

²⁶⁴ Provision on classification of waters and categorisation of watercourses in the RS dated 15 August 2001

Water users, on their hand, have some specific requirements for securing water quality in predefined areas, sections or places of abstraction in specific period of time. Water demand, of predefined use value, regardless of whether the issue is abstraction and use of water or securing ecological water functions, by rule, is stricter in the area of qualitative characteristic than it is actually possible to provide in the present circumstances, thus, conditions to achieve and maintain the required water quality are created through, among other things, the process of designating certain areas protected.

In addition to pollution which has the character of permanent and to some extent known, in certain and especially in water scarcity periods, pollution observed in waters has the character of accidental and emergency. Specificity of water quality protection issues, as well as defining the operational objectives, arises from the origin of the pollution according to which all polluters can fall under those whose emission has characteristics of dotted, concentrated introduction into waters or it is of spatial character and its origin, transport and introduction into aquifer cannot be linked to a concrete place in space.

Focusing on phenomena and occurrences which largely impact water quality alteration, areas according to which operational objectives were set out are clearly singled out:

- Point sources of pollution,
- Nonpoint sources of pollution,
- Determining the regime of use of an area which has significant impact on achieving and maintaining the quality of surface water and groundwater (protected areas).

Based on the above given introduction and defined strategic objectives, operational objectives, with measures for achieving them, have been identified as follows:

Operational objective 15:	Development of Water Management Plan for Sava River Basin District and Adriatic River Basin District
Operational objective 16:	Reduction of pollution from urban/sanitary waste waters
Operational objective 17:	Reduction of emission of hazardous and toxic substances produced by individual industrial polluters through establishment of the emission limit values system and polluter pays principle
Operational objective 18:	Reduction in levels of pollution that reaches surface waters and groundwater from regulated and unregulated solid waste landfills
Operational objective 19:	Reduction of pollution from agricultural activities
Operational objective 20:	Reduction of pollution from activities related to forest management
Operational objective 21:	Development of system for collecting, draining and treatment of waste water for settlements of less than 2,000 inhabitants
Operational objective 22:	Reduction of pollution from traffic
Operational objective 23:	Establishment of protected areas in accordance with the Law on Water of FBiH

4.3.6.4. Quality of surface water and groundwater

4.3.6.4.1. Operational objective 15: Development of Water Management Plan for Sava River Basin District and Adriatic River Basin District

This operational objective, foreseen by the LOW of BiH Federation in Articles 31 and 32, needs to be achieved as a prerequisite of all activities leading to achieving and maintaining good status or good ecological potential of surface water and groundwater.

Measures for this operational objective are also defined by the Law on Water of BiH Federation as follows:

- Development of methodology for designation of surface water body types and characterization of surface and groundwater body types,
- Defining reference conditions for classification of ecological status and permitted limit values of chemical quality parameters for classification of chemical status of surface water bodies,
- Defining parameters of quantitative and chemical quality for classification of the status of groundwater bodies,
- Establishment of the surface and groundwater quality monitoring system arising from the Monitoring Programme²⁶⁵,
- Drafting and publication of official record on the content and manner of adoption of Water Management Plan – Working Plan for preparation of Water Management Plan,
- Development of Water Management Plan according to the elements laid down by the FBiH Law on Water including Programme of Measures.

4.3.6.5. Water quality protection against point sources of pollution

According to the specificities of origin, and application of potential measures contributing to achieving the strategic objective related to point sources of pollution, operational objectives and measures are grouped to those related to pollution arising from urban and industrial waste water, landfills and waste, and other pollution which are characterized as point sources of pollution.

Urban waste water:

Consequence of uncoordinated development and improving standards in the area of public water supply results in a consequence of unacceptably low level of resolution of issues regarding collection and treatment of waste water produced by population.

Primary objective in environmental protection, and thus protection of water against urban waste water, is to increase the level of coverage of population by sewerage system where the end point of sewerage system is the water treatment plant of appropriate capacity and treatment degree in line with Directives (91/271/EEZ, 98/15/EEC) and EC Directive No. 1882/2003²⁶⁶ on urban waste water.

²⁶⁵ Developing monitoring of surface water and groundwater in line with the adopted plans: Monitoring of ecological status and chemical status of surface waters and Monitoring of chemical status of groundwater

²⁶⁶ Directive on urban waste water dated 21 May 1991 and 27 February 1998

Obligations and timelines arising from these as well as from the Directive 2006/118/EC²⁶⁷ on the protection of groundwater, are given in Chapter IV Legal Framework, in item titled Objectives Arising from the EU Requirements, while in terms of domestic legislation, this area is covered by the LOW. According to Article 54, item 3 of the LOW, local community, i.e. municipal council, except in cases of inter-municipal systems for which the Canton is competent, adopts decision on waste water discharge and obligation of connection to sewerage systems for some polluters/facilities. These decisions should also cover those parts of municipality for which there is no acceptable option of being included in the public sewerage system.

“Water Quality Management at the Level of River Basin Districts in BiH” (WQM I i II)²⁶⁸ project, financed by the European Community, was implemented during 2006–2008 period, and considered the aspect of water quality protection on the entire territory of BiH in details. The problem is primarily focused on pollution generated from waste water produced by population, i.e. urban waste water.

According to data contained in this project, 93 agglomerations were identified from the aspect of obligations of waste water collection and treatment on the territory of BiH Federation with over 2000 inhabitants out of which 75 are located in the Sava River Basin District and 18 in the Adriatic River Basin District. Out of total settlements, 23 are classified as priority as the starting point was the assumption that the connection level will be 60% in the first implementation phase²⁶⁹.

4.3.6.5.1. Operational objective 16: Reduction of pollution from urban/sanitary waste waters

Following the frameworks given in the relevant Directives and Stabilisation and Association Agreement (SAA) as well as in the current Water Quality Management Plan (WQM I and II), this operational objective can be defined as construction of urban waste water collection and treatment system for all agglomerations of over 2000 inhabitants with the following planned connection level until the end of Strategy’s planned period:

Size of settlement	Planned percentage of connection	Number of inhabitants
Settlement of 2000 – 10000 p.e.	70	197,500
Settlement of 10000 – 15000 p.e.	75	125,000
Settlement of over 15000 p.e.	90	917,000
Total		1,239,500

According to the established criteria, sewerage and waste water systems will cover approximately 1,240,000 inhabitants. Having in mind the forecasted number of inhabitants in BiH Federation at the end of Strategy’s planned period (2,756,814 inhabitants, 2020), the percentage of coverage of population by systems for collection, transport and treatment of waste water will be 45%²⁷⁰.

It is important to adequately prepare and monitor implementation of such important activities, which lack relevant experience, in order to carry out inevitable corrections and valorisation of

²⁶⁷ Directive 2006/118/EC of the European Parliament and Council dated 12 December 2006 on protection of groundwater against pollution and deterioration of status

²⁶⁸ Consortium Carl Bro a/s with REC BiH and NERI – 2007

²⁶⁹ Total investment costs for construction of urban waste water treatment plant for these agglomerations amount € 274 million, i.e. cost of sewerage with 60% connection is € 103.86 million, where these costs include only the cost of construction of faeces sewerage pipelines.

²⁷⁰ In total, inhabitants living in settlements of less than 2000 inhabitants (338.000 inhabitants) should be added to this number, who will resolve the issue of collection and treatment of waste water (planned by Operational objective 21) at the time this Strategy is in force. Thus, at the end of Strategy’s planned period, around 1,578,000 inhabitants will be covered by the system what will represent around 57% of the foreseen number – 2,756,814.

results through periodic evaluations. Due to this, but not only because of these activities, it is necessary to improve the system of collection and processing of statistical data from water sector which could then be used, as reliable and verified, in the procedure of adopting and amending management decisions.²⁷¹

Measures:

- Adoption of decisions on the manner of collecting, draining and treatment of waste waters in accordance with the FBiH Law on Water, Article 54.²⁷²;
- Increase of the degree of coverage of population with sewerage systems and construction of appropriate facilities for waste water treatment;
- Development of guidelines and guidebooks as support in selection and standardization of the appropriate technologies of urban waste water treatment and sludge processing, harmonized with the requirements of effluent quality according to the rulebooks in effect;
- Periodic evaluation of results of the implemented measures and further research aimed at providing better and more accurate grounds for decision-making.

Industrial waste water:

Specificity of waste water generated from industry is reflected in the fact that it contains atypical pollution whose quantity and type depends on a range of factors among which the most important are type of industry, applicable technological process and size of production capacities. Monitoring of waste water originating from business operators should be established so as to define it through several steps and relate to each individual operator, and base on the principle of issuing permits whose one element is water authorization, one's own monitoring of pollution emission, control measuring and surveillance, as well as establishment of a service that would efficiently implement and control these steps.

At the same time, business operators wishing to sell their products on global market should, as part of certification and standardization obligations, fulfil international ISO standards such as ISO 14000, 14040 and 14044 which include the obligation of development and implementation of Waste Water Management Plan covering the occurrences of accidental and emergency pollution, as well as steps taken and measures used in those cases.

Adoption of principles given in IPPC Directive on integrated pollution prevention and control²⁷³ related to industrial polluters, i.e. their obligations with regard to application of best available technologies (BAT) or best available technology not entailing excessive cost (BATNEC), largely provides for norms regarding the permitted discharge. Industrial polluters are thus stimulated to apply technologies which reduce the load of pollution at the point of origin through applying the polluter pays principle.

Industrial polluters frequently represent a source of dangerous substances which in long-term degrade water resources or they lose their use value forever. In this sense, Annex IX of the WFD,

²⁷¹ In the phase of analysis of the status of discharge and treatment of waste water, a problem was noticed regarding the unreliability and technological non-definition of data in the official statistical newsletters published by the Federal Office of Statistics, hence, better coordination is needed in this sense among this institution, utility companies and water management agencies.

²⁷² Article 54 of the Law on Water of BiH Federation: General obligation of waste water discharge and treatment

²⁷³ Directive 96/61/EC dated 24 September 1996

together with other directives²⁷⁴, defines the limit values of dangerous substances; and Directive on pollution caused by certain dangerous substances²⁷⁵ repealed the old Directive or parts of the Directives 76/464/EEC and 91/692/EEC which regulated the same area.

4.3.6.5.2. Operational objective 17: Reduction of emission of hazardous and toxic substances produced by individual industrial polluters through establishment of the emission limit values system and polluter pays principle

Measures:

- Establishment and maintenance of a register of industrial polluters;
- Efficient issuance of prior water authorisation with the aim of issuing environmental permits;
- Establishment of a system of continuous monitoring of effluents from polluters and strengthening control monitoring with the aim of observing terms and conditions laid down in environmental permits.

Solid waste landfills:

Low level of coverage by waste collection and disposal services on the territory of BiH Federation resulted in large number of areas used for unauthorized disposal of different types of waste (estimate done since 1893); while according to data of Federal Directorate for Civil Protection from June 2005, there are 21 regulated, i.e. 33 partially regulated municipal landfills on the territory of BiH Federation. Level of regulation and manner of management of these landfills do not guarantee safe and efficient control of operations and reducing negative effects these sources of pollution have on surface water and especially on groundwater.

Due to this, and along with appropriate measures of reducing pollution load, it is necessary to foresee appropriate monitoring of water resources in the zone influenced by landfills.

4.3.6.5.3. Operational objective 18: Reduction in levels of pollution that reaches surface waters and groundwater from regulated and unregulated solid waste landfills

Measures:

- Priority removal of unregulated waste landfills and waste disposal sites from zones that have negative impact on surface water and groundwater;
- Rehabilitation of the existing and construction of new solid waste landfills according to the Waste Disposal Strategy and plans which will be developed in accordance with the European Directives in effect;
- Development of capacities for adequate collection and disposal of mining and industrial waste.

4.3.6.6. Protection of water against nonpoint sources of pollution

Significance of nonpoint sources of pollution on the territory of BiH Federation is still not satisfactorily quantified as regards its share in total pollution load, and lack of appropriate by-laws prevents good management of the area identified as source of dispersed water pollution.

²⁷⁴ Directive 84/491/EEC, 83/513/EEC, 84/156/EEC, 82/176/EEC

²⁷⁵ Directive 2006/11/EU dated 15 February 2006

One of the most significant nonpoint sources of pollution are agricultural activities, cultivation and exploitation of forests, all types of traffic and roads, as well as scattered rural settlements of 2,000 inhabitants which are not covered by the Directive on urban waste water in which, according to estimates, approximately 47% of the total population of BiH Federation live.

Solution of collection and appropriate treatment of waste water generated by inhabitants living in settlements of less than 2,000 inhabitants, at the size of 25% (50% of populated area with 50% coverage of inhabitants), would cover 338,000 inhabitants at the end of period covered by this Strategy, what totals to approximately 12% of the total number of inhabitants.

4.3.6.6.1. Operational objective 19: Reduction of pollution from agricultural activities²⁷⁶

Measures:

- Quantification of pollution load from agricultural activities in areas with its noticeable influence through establishment of an appropriate monitoring and control system;
- Water sector participation in development of FBiH agro-environmental programme as part of the integral land management system with emphasize on water protection;
- Application of principles of good agricultural practice through implementation of action plans and guidebooks which include measures pertaining to sustainable use of manure and protection substances.

4.3.6.6.2. Operational objective 20: Reduction of pollution from activities related to forest management

Measures:

- Participation in adoption of forest management plans as planning documents which contain the manner of usage of forest resources/space in areas of mutual interest to water users and forest management bodies;
- Carrying out multidisciplinary surveys aimed at determining effects of forest management to qualitative – quantitative water regime.

4.3.6.6.3. Operational objective 21: Development of system for collecting, draining and treatment of waste water for settlements of less than 2,000 inhabitants

Measures:

- Launching and implementation of pilot projects with the aim of identifying acceptable technologies for smaller settlements;
- Development of guidelines, definition of norms and construction of sewerage systems and facilities for waste water treatment for around 25% of population living in settlements of up to 2,000 inhabitants.

²⁷⁶ In line with the Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources

4.3.6.6.4. Operational objective 22: Reduction of pollution from traffic

Measures:

- Survey of effects of pollution from all types of traffic;
- Elaboration of procedures in the process of issuing environmental permits along with ensuring participation of water sector representatives through efficient issuance of water authorisations for reconstruction of the existing and construction of new roads.

4.3.6.7. Protected areas

To date, only 0.6% of the total territory²⁷⁷ of BiH Federation is under some regime of protection, and the situation in BiH Federation in comparison with the one in Republic of Srpska is unfavourable. As a rule, use of an area disturbs natural relations governing the situation without anthropogenic influence, what is also reflected on the change of qualitative and quantitative water regime. BiH Federation LOW (Article 65) determined the areas that need to be designated as protected areas from the aspect of their purpose, i.e. water use; and these are eutrophicated areas as well as areas which have to be protected in order to provide for survival of aquatic flora and fauna.

Implementation of water protection policy has to be observed within the active participation in management of an area what includes spatial planning, assessment of area's vulnerability and prescribing measures and limitations regarding use of the area. More than any other, this area is subject to different disciplines (spatial planning, protection of cultural and nature resources, health, energy, tourism, etc.) but, regardless of the importance of other forms of water use and reasons for their protection, protective zones of drinking water sources are imposed as priority in establishment of protected areas.

In addition to protective zones which are in the function of securing sufficient volume of drinking water, in the part related to use of water for bathing²⁷⁸, as well as for other forms of use and fulfilling conditions for survival of aquatic ecosystems, it is necessary to implement protection measures for bodies of water intended for such purpose. More detailed data on protected areas, as well as their description and characteristic are given in Chapter I 2.6 and are related to national parks, nature parks, nature monuments, protected areas under the Law on Forests and areas of specific characteristics of importance for BiH Federation.

4.3.6.7.1. Operational objective 23: Establishment of protected areas in accordance with the Law on Water of FBiH

Measures:

- Technical and administrative designation of zones of sanitary protection of drinking water sources of public and local water supply systems whose capacity exceeds 10 m³/day;
- Development of technical basis and adoption of decisions on designation of areas intended for protection of economically important aquatic species in accordance with the existing regulations;
- Development of technical basis and adoption of decisions on designation of areas intended for

²⁷⁷ Protected areas of Bosnia and Herzegovina cover the area of 30,766.82 ha, which is 0.6 % of the total size (5,120,976 ha). Source: Federal Ministry of Environment and Tourism, Sarajevo, (website visited on 12 December 2008).

- water sport and recreation;
- Development of technical basis and adoption of decisions on designation of areas sensitive to nutrients and appropriate monitoring programme;
- Development of technical basis and adoption of decisions on designation of protected areas related to habitats of aquatic and semi-aquatic plant and animal species²⁷⁹;
- Setting up a database on the status of surface water and groundwater bodies by river basin districts and its integration into the WIS (Water Information System).

4.3.7. Protection against water

Strategic objective, set out for protection against water, is:

Strategic objective 9:	Reducing the risk at extreme hydrological phenomena
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4.3.7.1. Strategic objective 9: Reducing the risk at extreme hydrological phenomena

Increasingly frequent and more devastating consequences caused by water clearly demonstrate that the existing management and control systems are not efficient enough and require necessary and fast change of approach to and principles of fight against threats caused by surplus and/or lack of water. The fact is that disasters hit the rich and the poor alike²⁸⁰ and that they represent obstruction to national, regional and global development. Today, we live with environment which is increasingly vulnerable and exposed to risks of flood, drought, landslides, sludge flows, pollution of water and soil. European report on climate assessment gives data on an observed trend of more humid extremes while number of warm days increased with regard to the average; and floods are more frequent and with larger flow rates. Longer periods of smaller level of precipitation than the average what leads to droughts and creation of large problems in management of water and water-dependant resources are also observed. Natural disasters cannot be controlled but there is a possibility of reducing social vulnerability through adoption of measures for mitigation of water disasters. All this leads to an urgent need for commencing the process of coordination of multidisciplinary and interdisciplinary research and undertaking other activities and measures regarding the issue of water risks.

Within the integrated water management, it is important to identify *strategic objectives* and tasks in order to carry out efficient protection against floods, improve the level of protection against adverse effects of water, mitigate consequences of drought, and prepare for fulfilling *obligations* arising from accession process and later the EU membership; in particular, Water Framework Directive (WFD)²⁸¹ and Directive on the assessment and management of flood risks.²⁸²

4.3.7.2. Operational objectives and measures for the area of water protection

To achieve strategic objective of Reducing the risk at extreme hydrological phenomena it is necessary to define the following operational objectives and measures for their implementation.

²⁷⁹ Directive 2006/44/EC dated 6 September 2006 concerning quality of fresh water needing protection or improvement in order to support fish life and Directive 2006/113/EC dated 12 December 2006 on the quality required of shellfish waters

²⁸⁰ Disasters cause 2% damage in developed countries and 13% of gross national income in developing countries

²⁸¹ Directive 2000/60/EC of the European Parliament and the Council dated 23 October 2000 (Directive 2000/60/EC)

²⁸² Directive 2007/60/EC of the European Parliament and the Council dated 23 October 2007 (Directive 2007/60/EC)

Operational objective 24:	Reconstruction and rehabilitation of the existing and construction and maintenance of the system of protection facilities with the aim of increasing the safety level in terms of protection against floods
Operational objective 25:	Development and adoption of plans for protection against adverse effects of water
Operational objective 26:	Reduction of erosion
Operational objective 27:	Setting out programmes to combat droughts
Operational objective 28:	Prevention and preparedness in cases of disaster – dam demolition or overflow

4.3.7.2.1. Operational objective 24: Reconstruction and rehabilitation of the existing and construction and maintenance of the system of protection facilities with the aim of increasing the safety level in terms of protection against floods

Measures:

Analysis carried out of the existing status and securing functioning of flood protection systems and structures indicates that it is necessary to define priorities and areas in which the following measures need to be implemented:

- Reconstruction of the existing flood protection facilities up to the necessary level of protection corresponding to the importance of defended area and scope of damage which could be inflicted by potential high water flood of specific grade of the phenomena.

This includes all measures on completion of facilities under construction and reconstruction of the existing water structures and facilities to correspond to the suitable applicable parameters and dimensions in line with the level of protection. Complete the remaining works related to rehabilitation of polders in Posavina and other areas.

- Construction of protection structures against high waters in endangered areas by priorities.

Progressively construct protection structures along the rivers based on cost-benefit analysis.

- Ensuring functionality of the existing protection structures against adverse effects of water.
- Providing support to planning and establishing “multipurpose water systems” (where effects of these structures are manifested on a wider area and greater number of important economic and other facilities) in cooperation with primarily the energy, agriculture and spatial planning sectors.

Give preference to construction of multipurpose systems since dams and reservoirs are the main structures for flood control. Regarding designing and managing reservoirs, it is necessary to pay attention to economic, social and ecological needs in order to minimize negative and achieve maximum positive impact. Complex issues of flood protection can be very successfully resolved in certain areas by levelling the streams – construction of multipurpose reservoirs (various users of water and land). Maximum flows of flood waves can be successfully reduced through retention capacities: water flows, land and flood areas (especially on medium- and small-size river basin districts). Retained water would be infiltrated into the ground thus ensuring better conditions for ecosystems, availability for future uses and at the same time reducing risks of extreme floods. Natural wetlands and flood areas should be preserve (if possible even extended), forest areas (as retardation areas) should be maintained and increased (afforestation) while special attention

should be paid to hilly parts of the river basin districts where torrential erosion is especially evident. Protection of watercourse banks (if possible) should be resolved with vegetation. Renaturalisation measures (though related to costly land expropriation) should be supported. It is necessary to give preference to and support all programmes which will improve the status of environment. In urban areas, urban planners should foresee parks and green areas in order to ensure as better as possible infiltration of storm water into the ground.

- Facilitate coordinated activities of water and agricultural sector for the purpose of revitalization of the existing melioration systems and facilitation of their development in accordance with the plans and needs of agricultural consumers as well as needs for protection of settlements against adverse effects of inland waters.

The first condition for melioration system functioning is protection against external waters²⁸³, along with regular investment in and technical maintenance of water structures. Priorities in planning of hydro-technical measures will be determined in line with financial capacities and based on the rate of profitability. Resolving the issue of melioration drainage also represents a solution to protection of acreages and settlements located in the systems against floods caused by inland water (Orasje, Odzak, etc.).

4.3.7.2.2. Operational objective 25: Development and adoption of plans for protection against adverse effects of water

Measures:

- Development and implementation of operational flood and ice defence plans,
- Development of preliminary assessment of flood risk, map of threats and map of flood risks as well as flood risk management plans:²⁸⁴

Development of Water Management Plan for the Sava River Basin District and Adriatic River Basin District has to include flood risks management plans²⁸⁵ what are the elements of integrated management of water resources. Based on the available data (existing studies and documentation), effects of climate changes, defined objectives and measures (flood risk management), EU recommendations and guidelines, as well as additional analyses, it is necessary to:

- Conduct preliminary flood risk assessment,
 - Develop flood threat maps and flood risk maps,
 - Establish flood risk management plans,
 - Conduct revision (update) of flood risk management plans.
- Establishment of a database (within the water information system - WIS) and flexible monitoring system with the aim of submitting data on water levels, flow rates and precipitation. Establishment of the model of forecast of flow rate and reservoir management. Defining manner of information and warning.

²⁸³ Strategic Plan (2009-2019) – the vision of mine-free BiH in 2019 is at the same time a condition for potential access to land improved areas

²⁸⁴ Decision on types and contents of plans of protection against adverse effects of water (Official Gazette of BiH Federation, No.26/09 dated 15 April 2009)

²⁸⁵ Under the Directive 2007/60

Flood management is a very complex task since watercourses serve for numerous different and sometimes contradictory functions. In times of floods, the priority task is rescuing human lives, assets, environment, etc. The role of early warning is of invaluable importance at that time. Flood early warning system includes collection of data from the field and assessments of threat at the spot in order to provide an accurate forecast.²⁸⁶

For the purpose of as efficient as possible flood defence, it is necessary to continuously improve the systems of monitoring and forecasting hydro-meteorological phenomena, and define flood management prevention measures as well as flood management operational measures which are the basis of operational implementation of management measures in flood periods.

- Coordinating work of specialized services (meteorological, users of reservoirs, spatial planners, protection and rescue services), as well as units of local self-government, farmers, environmental scientist, foresters, non-governmental organizations, entrepreneurs, citizens and media.

Coordinated work on tackling issues of and improving flood protection requires application of a range of integrated, systematic and efficient preventive construction and nonconstruction measures. Necessary precondition for implementing these measures is active and coordinated participation of all stakeholders in water management process as well as specialized services. Adequate protection of potentially threatened areas in realized through application of construction measures while implementation of nonconstruction measures significantly improves the status of flood safety.

Based on Article IV.b.7 of the Constitution of BiH Federation, the Law on Protection and Rescue of People and Material Goods against Natural and Other Disasters was enacted under which:

- *Protection services* should secure good functioning (cantonal and local) of centres for early warning of population, organize the activities of civil protection, develop operational plans of action in cases of disaster, occasionally organize exercises, organize evacuation of population if needed, organize emergency medical care, organize rehabilitation of the area after floods.
- *Research and development institutions* should intensify development of projects regarding: (i) improvement of meteorological and hydrological forecasts of rainfall (and snow melting), (ii) regional hydrological analyses of high waters, (iii) maintenance of rainfall in the river basin district (agricultural and forest production), (iv) improvement of protection of certain areas, (v) analysis of potential damages, (vi) inclusion of general public.
- *Education of population*: global experience in flood management drew attention to particular importance of preparation for emergency situation, establishment of IT centre based on usage of GIS. Special attention has to be paid to education, training of population and communication with general public. It is necessary to improve measures of testing safety of dikes and dams, lock chambers and dams, and work on a new approach to reservoir management. Floods are disasters which can be understood only through interdisciplinary approach, by combining experience from different areas.

²⁸⁶ Various early warning systems have been developed around the world. Unfortunately, they proved inefficient in crisis moments of extreme floods, especially in forecasting sudden flood in urban areas.

4.3.7.2.3. Operational objective 26: Reduction of erosion

Land erosion creates extremely large and long-term damages, endangering multiple industry branches at the same time: agriculture, forestry, water management, transport, communications, utility infrastructure, settlements, economic interventions, etc. Mostly partial protection measures of interest for the institution implementing them have been applied to date. Far more efficient effects would be achieved if the mentioned actions would be coordinated and the approach to the issue multidisciplinary. It is necessary to develop and adopt Erosion Protection Strategy and Programme under coordination of the competent Ministry of Agriculture, Water Management and Forestry of FBiH and Ministry of Environment and Tourism as well as Ministry of Physical Planning.

Measures:

- Development of erosion protection programme,
- Implementation of general anti-erosion measures:

Independently of local conditions, general anti-erosion measures are: legislative measures, development of cadastre of erosion, monitoring of erosion processes, education of population, integration of erosion protection issues in: spatial plans, forest management plans, and, of course, planning documentation of water sector. Erosion can be significantly reduced by proper land cultivation and maintenance of vegetative cover.

- Mitigation of damages caused by erosion:

Approach to rehabilitation measures must be analysed in details, containing emphasized priorities in order not to disturb the natural balance of watercourses and river basin districts. Erosion protection has to be carried out according to the established criteria which depend on: significance and priority of protective water structure, level of threat of covering with fill, level of susceptibility to covering with fill, and level of justification of works (profitability rate).

4.3.7.2.4. Operational objective 27: Setting out Programmes to combat droughts

Lack of water is presently the problem that growing number of regions face, and the trend is increasing.²⁸⁷ The impact of lack of water on environment and its consequences to social-economic and political developments result in system productivity crisis, especially food production, and is thus included among disasters with the severest consequences. The issue of tackling these problems requires an interdisciplinary approach. Water scarcity risk management requires implementation of the following activities: (i) forecast, (ii) monitoring and (iii) assessment of consequences. Defining the status and monitoring is carried out through: monitoring the network of meteorological and hydrological stations in the region, analysis of satellite shots and inspection on the field, primarily of the status of vegetation. Decisions related to water scarcity phenomena should be adopted based on comparison of systems in the wet status conditions and conditions of lack of water. The objective of water scarcity impact assessment is to understand the levels to which functioning of society, economy and environment can be endangered.

²⁸⁷ Subregional Drought Center for South East Europe exists in Republic of Slovenia since 2006

Measure:

- Involvement in EU activities related to water shortage.

The recent researches in hydrology and climate modelling show that the probability of extreme precipitation (in winter period) and extreme droughts (in summer period) phenomena is increasing. Therefore, it is necessary to incorporate droughts in flood defence action plans.

4.3.7.2.5. Operational objective 28: Prevention and preparedness in cases of disaster – dam demolition or overflow

Having in mind the fact that dam demolition can happen in cases of catastrophic earthquakes, in cases of subsequent land subsidence and losing constructive and load-bearing characteristics of land in the zone of dam and reservoir, due to inadequate observance of plant plan and regime of operation of hydro-reservoirs, as well as in warfare, a need for implementation of the following measures imposes itself:

Measures:

- Development of periodic Studies on status and stability of the existing facilities in function as well as preparation of the Study on effects of flood wave (primary and secondary) on people and material assets in flood-prone area.
- Development of the Study on early warning of people of flood wave threat, i.e. flood, installation of automatic measurement stations and water level detectors on all larger watercourses and downstream from dams.

5. Plan for implementation of measures for fulfilling water management objectives

5.1. Introduction and overview of the Plan

The Plan for implementing measures for fulfilling water management objectives giving: competent institutions, planned implementation timeline, parameters according to which the level of success of measures implemented will be assessed and assessment of investment funds needed, is given in Table 5.1.

The year 2008 (signature and ratification of the Stabilization and Association Agreement with the European Union - SAA) is selected as the reference date, in particular for legal framework of the activities. In Strategy's 12-year planned period, until 2022, the important year is 2014 as the year of planned association with the EU, under the SAA.

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
1	LEGAL FRAMEWORK FOR WATER MANAGEMENT				
1.1.	Legal reform of water sector arising from the need to adapt to the new social circumstances along with the alignment to the EU requirements in the area of water management as part of the process of BiH stabilisation and association to the EU				
	<i>Reference date: 16 June 2008 (Signature of Stabilisation and Association Agreement with the EU – SAA)</i>				
	I SAA Implementation				
1.1.1.	Enactment of by-laws. Derogation of all regulations on water enacted prior to the Water Law from 2006.	FBiH Government (in consultations with RS Government; upon the proposal by the minister, in some cases with approval of other ministers); minister; Federal Minister of Environment; FMH, FMIP, Cantonal governments	2009	“Official Gazette of FBiH”. Deadline for transposition according to the 2006 Water Law, planned/updated in line with deadlines of certain Directives and under the SAA. Published text	
	<i>First Annual SAA Progress Report</i>		2009		
1.1.2.	Commencement of full application of new regulations	Legal and natural persons on the territory of FBiH. Competent institutions: FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, FMET	2010	All enacted by-laws. Report on inspection controls. Assessment in SAA implementation reports.	
	<i>Second Annual SAA Progress Report</i>		2010	Published text.	
1.1.3.	Detailed assessment of SAA implementation (water management aspect)	Competent bodies of Bosnia and Herzegovina, FBiH Government, FMAWMF	2011	Detailed table overview of harmonization. Published assessment text.	
1.1.4.	Revision of all BiH Federation water legislation (laws and by-laws)	FBiH Parliament, FBiH Government, FMAWMF	2012	Drafted, enacted and published amendments to the Law on Water of BiH Federation and all by-laws on water.	
1.1.5.	Enforcement and implementation of new regulations, further transposition, capacitating institutions for enforcement of regulations	Competent bodies of BiH, FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency. Competent inspection bodies	2012	Assessment of enforcement in reports on SAA implementation. Other published reports, including inspection reports.	
				Subtotal 1.1	800,000.00

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
II Transposition and Implementation of Directives					
1.2.	Objectives arising from EU requirements				
1.2.1.	Water Framework Directive (WFD) (2000/60/EC).				
	Full transposition	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2012	Regulations published in the Official Gazette of FBiH. Detailed table of harmonization.	
	Characterisation of river basins	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2011	Regulations of BiH Federation in line with the WFD. Report on SAA implementation and other reports.	
	Defining Monitoring Programme	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2012		
	Beginning of consultations with the public (on specific elements of Water Management Plans for the Sava River Basin District and Adriatic River Basin District)	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2012		
	Preparation and public presentation of Water Management Plans for Sava River Basin District and Adriatic River Basin District	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2015		
	Adopted water management plans for river basin districts	FBiH Government, FBiH Parliament, FMAWMF	2016		
				Subtotal 1.2.1.	250,000.00
1.2.2.	Urban Waste Water Treatment Directive (91/271/EEC)				
	Full transposition	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2009	Regulations published in the Official Gazette of BiH Federation. Prepared detailed summary of harmonization with the Directive 91/271.	

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
	Designation of sensitive and less sensitive areas	Federal Minister of Environment, BiH Ministry of Foreign Trade and Economic Relations (Department for Natural Resources, Energy and Environment) in certain cases.	2010		
	Responsibility of secondary urban waste water treatment of all agglomerations of more than 15000 p.e.	Canton, municipality, city, (owners of hydro-technical utility facilities); industrial pollutants	2018	Waste water treatment facilities constructed. (Due to the amount of investment, full achievement of this objective will also be negotiated in the period following 2014 but not after 31 December 2016).	
	Responsibility of secondary urban waste water treatment of all agglomerations of between 10000-15000 p.e.	Canton, municipality, city, (owners of hydro-technical utility facilities); industrial pollutants	2023	Waste water treatment facilities constructed. (Due to the amount of investment, full achievement of this objective will also be negotiated in the period following 2014 but not after 31 December 2020)	
	Regarding discharge of waste water into sensitive areas, responsibility of a more stringent treatment than the secondary one of all agglomerations of more than 10000 p.e.	Canton, municipality, city, (owners of hydro-technical utility facilities); industrial pollutants	2016	Waste water treatment facilities constructed.	
	Revision of all approvals and permits regarding collection and manner of discharge of urban waste water	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2013	New permits issued. (Relates to introducing industrial waste water into urban sewerage systems)	
	Definitive prohibition of disposal of sludge to surface waters by dumping from ships and by discharge from pipelines or by other means	FBiH Government, FMAWMF	2010	Regulation on prohibition published.	
				Subtotal 1.2.2	350,000.00

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
1.2.3.	<i>Directive on the protection of groundwater</i>				
	Full transposition	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2012	Published regulations. Prepared detailed table of harmonization.	
	Established limit values of concentrations and pollutants.	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2013	Published regulations. Prepared detailed table of harmonization.	
				Subtotal 1.2.3	100,000.00
1.2.4.	<i>Directive on protection of groundwater against pollution caused by certain dangerous substances (80/68/EEC)</i>				
	Full transposition	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2012	Published regulations. Prepared detailed table of harmonization.	
				Subtotal 1.2.4	50,000.00
1.2.5.	<i>Directive on environmental quality standards for water²⁸⁸</i>				
	Full transposition	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2011	Published regulations. Prepared detailed table of harmonization.	
	Establishing a monitoring system	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2013	Report on SAA implementation, reports on monitoring results for general public.	
				Subtotal 1.2.5	50,000.00

²⁸⁸ Commission proposal went through the second reading in the EU institutions, thus, enactment of this Directive can be expected soon. Due to its significance, it is necessary to plan for transposition and enforcement already in this planning phase.

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
1.2.6.	<i>Directive on quality of water for human consumption (98/80/EC)</i>				
	Full transposition	FBiH Government, Federal Minister responsible for Health, FMAW/MF, Sava RBD Agency and Adriatic Sea RBD Agency	2011	Published regulations. Prepared detailed table of harmonization.	
				Subtotal 1.2.6	50,000.00
1.2.7.	<i>Directive on bathing water quality (2006/7/EC)</i>				
	Full transposition	FBiH Government, FMAW/MF, FMH, Sava RBD Agency and Adriatic Sea RBD Agency	2009	Published regulations. Prepared detailed table of harmonization.	
	Designation of bathing water	Municipality, city	2010	Adopted and published individual decisions. Reports on SAA implementation and other reports.	
	Assessment of bathing water	Municipality, city			
	Classification and status of bathing water	Municipality, city			
	Public awareness	Municipality, city	2011	Published official information.	50,000.00
				Subtotal 1.2.7	350,000.00
1.2.8.	<i>Directive on protection of water pollution caused by certain dangerous substances (2006/11/EC)</i>				
	Full transposition	FBiH Government, FMAW/MF, Sava RBD Agency and Adriatic Sea RBD Agency	2012	Published regulations. Prepared detailed table of harmonization.	
	Environmental quality standards for water	FBiH Government, FMAW/MF, Sava RBD Agency and Adriatic Sea RBD Agency	2013		
	Programme for establishing emission limit values	FBiH Government, FMAW/MF, Sava RBD Agency and Adriatic Sea RBD Agency	2014	Adopted and published programme.	
	Preparation and submission of the report to European Commission	FBiH Government, FMAW/MF, Sava RBD Agency and Adriatic Sea RBD Agency	2014	Prepared and submitted report.	
				Subtotal 1.2.8	250,000.00

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
1.2.9.	<i>Directive on protection of waters against pollution caused by nitrates (91/67/EEC)</i>				
	Full transposition	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2009	Published regulations and individual decisions. Prepared detailed table of harmonization.	
	Designation of sensitive and vulnerable zones	Federal Minister responsible for Environment. BiH Ministry of Foreign Trade and Economic Relations (Department for Natural resources, Energy and Environment).	2010		
	Revision and amendments to the decision on sensitive zones	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, Federal Minister responsible for Environment	2014	Published, revised and amended individual decisions	
	Code of good agricultural practice	FMAWMF, Department for Agriculture	2011	Published code.	
	Implementation of agriculture training programme	FMAWMF, Department for Agriculture	2011	Training executed. Published programme implementation report.	
	Preparation of Action Plan for especially sensitive zones	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, FMET	2013	Adopted and published Action Plan.	
	Implementation of a one-year monitoring programme	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, FMET	2010-2011	Published one-year monitoring programme. Published results of one-year monitoring.	
	Overview of eutrophication status of surface waters, water in estuaries and coastal sea waters	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, FMET	2012	Published programme of preparation of overview, and preparation of information for general public.	
	Preparation and submission of the report to European Commission	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2013	Prepared and submitted Report. (Report is submitted within 6 months as of end of four-year timeline to which it pertains).	
				Subtotal 1.2.9	850,000.00

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
1.2.10.	<i>Directive on quality of water capable for supporting fish life (2006/44/EC)</i>				
	Full transposition of the Directive	FBiH Government, FMAWMF, FMJP, Sava RBD Agency and Adriatic Sea RBD Agency	2010	Published regulations. Prepared detailed table of harmonization.	
	Dividing water to salmonid and cyprinid water	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, FMAWMF-Department for Agriculture, FMET	2011	Published individual decisions.	
	Preparation of programme of measures for salmonid and cyprinid water	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, FMAWMF-Department for Agriculture, FMET	2013	Published programme.	
	Submission of the report to European Commission	FBiH Government, Sava RBD Agency and Adriatic Sea RBD Agency, FMAWMF, FMAWMF- Department for agriculture, FMET	2013	Published report.	
				Subtotal 1.2.10	225,000.00
1.2.11.	<i>Directive on quality required of shellfish waters (2006/113/EC)</i>				
	Full transposition	FBiH Government, FMAWMF, FMJP, Adriatic Sea RBD Agency	2010	Published regulations. Prepared detailed table of harmonization.	
	Designation of certain waters for shellfish	FMAWMF, Adriatic Sea RBD Agency, FMET	2011	Adopted and published individual decisions on designation.	
	Programme for reduction of pollution	FMAWMF, Adriatic Sea RBD Agency, FMET	2014	SAA. Deadlines could be extended but not after 31 December 2015	
	Report on implementation of the Directive	FBiH Government, FMAWMF, Adriatic sea RBD Agency, FMET	2013	SAA	
				Subtotal 1.2.11	125,000.00

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
1.2.12.	Directive on management of flood risks (2007/60/EC)				
	Full transposition	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2010	Published regulations.	
				Subtotal 1.2.12	50,000.00
1.2.13.	Drought and water scarcity				
	Inclusion in EU activities against effects of droughts and water scarcity	FMAWMF – department for Agriculture, competent bodies of BiH	2010	Published information for general public.	
				Subtotal 1.2.13	150,000.00
1.2.14.	Directive on INSPIRE (2007/2/EC)				
	Full transposition	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2009	Published regulations. Prepared detailed table of harmonization.	
	Preparation of Report I	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, FMAWMF-Department for Agriculture, FMET	2010	Published Report.	
	Preparation and submission of the first three-year report to European Commission	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2013	Published Report.	
				Subtotal 1.2.14	125,000.00
1.2.15.	Inclusion in intercalibration network (Decision C2005 3140)				
	Designation of sites for installation of intercalibration stations	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2011	Published information for general public.	
				Subtotal 1.2.15	50,000.00

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
<i>Deadlines outside the S44 implementation period for achieving objectives and implementation of measures laid down by the Strategy - long-term objectives</i> (Transposition and implementation of Directives)					
1.2.16.	Water Framework Directive (2000/60/EC)				
	Introducing pricing policy	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, competent Cantonal ministries, municipalities	2015		
	<i>First management cycle completed</i>		2016		
1.2.17.	Directive on urban waste water treatment (91/271/EC)				
	Responsibility of secondary urban waste water treatment of all agglomerations of more than 15000 p.e.	Municipality, city, canton (owners of hydro-technical utility facilities), industrial polluters	2014-2018	Secondary waste water treatment facilities constructed. (Due to the amount of necessary investments, full achievement of this objective in the period after 2014 but not later than 31 December 2016 will be subject to negotiations.)	
	Responsibility of secondary urban waste water treatment of all agglomerations of between 10000 – 15000 p.e.	Municipality, city, canton(owners of hydro-technical utility facilities), industrial polluters	2014-2023	Secondary waste water treatment facilities constructed. (Due to the amount of necessary investments, full achievement of this objective in the period after 2014 but not later than 31 December 2020 will be subject to negotiations.)	

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
1.2.18.	Directive on quality required of shellfish waters (2006/113/EC)				
	Preparation of programme for reduction of water pollution	FBiH Government, FMAWMF, Adriatic Sea RBD Agency	2015	Adopted and published Programmes. (Medium-term objectives timeline can be extended but not later than 31 December 2015)	
1.2.19.	Directive on management of flood risks (2007/60/EC)				
	Revision of preliminary assessment of flood risks	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2018	Revision of preliminary assessment completed and revised flood risk assessment published no later than 22 December 2018	
	Revision and update of maps of hazards and risks of floods	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2019	Revision of maps completed, and updated maps of hazards and risks of floods published no later than 22 December 2019	
	Adopting flood risks management plans	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2015	Plans adopted and published no later than 22 December 2015	
	Revision of flood risks management plans	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2020	Revision completed, and revised flood risk management plans published no later than 22 December 2021	
				Subtotal 1.2.16-1.2.19	200,000.00
				Total 1	4,025,000.00

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
ECONOMIC WATER MANAGEMENT FRAMEWORK					
2	Adequate integration of water management sector in economic system as a whole, with larger representation of the economic tools in the process of water resources management				
2.1.	<i>Economically more rational and environmentally more friendly management in water sector and implementation of measures for transition from the existing supply-side water management to the demand-side water management practice</i>				
2.1.1.	Detailed analysis of the existing and actually necessary costs with the aim of rendering water supply services and areas of potential financial losses, i.e. nature and cause of the loss, as well as possibilities for their reduction.	Cantons, municipalities, utility companies	2012	Number of implemented Studies	
2.1.1.1.	Development and implementation of criteria and standards of business operations of service providers in the sector of water supply and sanitation and linking with the price users pay for the service rendered.	Cantons, municipalities and utility companies	2012.	Established criteria and standards	
2.1.1.2.	Provision of transparency and feasibility regarding pricing, determining subventions and cross subventions.	Cantons, municipalities and utility companies	2012	Plan accepted by competent councils. Public access to water pricing structure realized.	
2.1.1.3.	Basing special water charges on international experiences and comprehensive analyses of total social and not only private costs and benefits especially with regard to determining needs, manners and degree of internalization of significant negative external effects	FMAWMF in cooperation with FMET, cantons, Environment Water Protection Fund of FBiH	2011.	Comparison with international experiences. Prepared report on analyses with recommendations.	

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
2.1.1.5.	Implementation of activities directed to raising public awareness on the importance of water, possible ways of saving and potential economic and environmental effects of measures for rational use of water	Competent cantonal ministries, municipalities	2009-2021 as continuous activity	Statistical data on reduction of specific water consumption	
2.1.1.6.	Economic analyses of possibilities for inclusion of rural areas into the public water supply and sanitation systems	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, cantons, municipalities	2011	Prepared and accepted study with defined criteria and analyses for rural areas	
				Subtotal 2.1.1	1,850,000.00
2.2.	Improving efficiency, transparency and accountability in water management				
	Provision of financial viability in water management and reform of water pricing system along with progressive introduction of economic price of water				
2.2.1.	<i>Progressive transition to the system that would ensure long-term sustainable funding in the area of water management and full recovery of costs by customers or other source</i>				
2.2.1.1.	Accurate definition of terms and conditions for reaching financial self-sustainability in all segments of water management, i.e. accurate definition of certain types of costs and amounts of total or full costs (operational costs, maintenance costs, depreciation, cost of capital, system extension costs, costs of external effects, costs of water as scarce resource)	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, competent cantonal ministries, utility companies	2011	Defined parameters for assessment of financial self-sustainability	

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
2.2.1.2.	Analysis of potentially new, additional sources of funding of investment interventions used in other countries and assessment of prospect of their use in BiH Federation with particular emphasis on mobilization of, for the time being, insufficiently used financial resources at the level of municipalities and Cantons	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, Association of Utility Companies	2011	Existence of the study with analysis of potential additional sources of funding	
2.2.1.3.	Achieving full harmonization of the relevant existing laws what would enable Tax Administration to perform control of payment of special water charges	FBiH Parliament, FBiH Government, FMAWMF, FMF	2010	Adopted amendments to the relevant law	
2.2.1.4.	Improvement of the degree of collection for rendered water supply and sanitation services	Municipalities and utility companies	2009-2021 as continuous activity	Statistical data on increased percentages of collection	
2.2.1.5.	Establishment of pricing system which reflects actual, economic, organisationally and technologically justifiable costs related to water supply and sanitation	Competent cantonal ministries, municipalities	2010-2020	Established improved pricing system	
2.2.1.6.	Determination of possibility for transition to calculation of prices for services by increasing block pricing system with subsidized first block of consumption and activities on its introduction what would facilitate simultaneous achieving the planned economic, social and environmental objectives in water management	Competent cantonal ministries, municipalities	2012 (for preparation of the Study)	Existence of the study with analysis of possibilities of introduction and recommendations regarding introduction of the system of new calculation	
2.2.1.7.	Harmonization of unit prices collected from households and legal entities for services of water supply and sanitation if water of the same quality is being considered.	Competent cantonal ministries, municipalities	2020	Decrease of differences in prices between households and legal entities	
2.2.1.8.	Increase in the amount of special water charges and commencement of collecting those charges that have not been collected thus far (e.g. special water charge for protection against floods, special water charges for abstraction of irrigation water)	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, FMET, Environment Protection Fund of FBH	2012	Existence of the study with analysis of adequacy of the existing charges and amount of collected charges. Decision on the amount of special water charges.	

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
2.2.1.9.	Analysis of possibilities for establishing one or more regulatory bodies responsible for determining the costs of services	FMAWMF, Sava RBD Agency, Adriatic Sea RBD Agency, competent cantonal ministries,	2013-2015	Existence of prescribed binding structure	
2.2.1.10.	Promoting establishment of public-private partnership in rendering services of water supply and sanitation, i.e. development of financial and regulatory instruments for the purpose of inciting private investments, determining clearly defined roles of the state, private sector and other stakeholders.	FBiH Government, FMAWMF, cantons, municipalities	2010 Development of instruments and def. of roles. Continuous – promotional activities	Degree of realization of public-private partnership. Data on the amount of invested private capital	
				Subtotal 2.2.1	2,530,000.00
2.2.2.	<i>Improvement of the decision-making process regarding forms of use of water resources</i>				
2.2.2.1.	Gathering and analysis of international experiences, good business practice and economic tools for validation of water in different purposes. Establishment of mechanisms for application of this practice and instruments at relevant decision-making levels	FBiH Government, Concession Commission, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, cantons, municipalities	2012	Prepared study with analysis of international experiences. Decision-making processes regarding awarding concession are based on results of the Feasibility Study and existence of public interest	
2.2.2.2.	Ensuring existence of appropriate regulatory framework as basis for determining concession fees for different forms of water use, starting with the objectives laid down by development documents for each sector (industry, electric power supply sector, agriculture, population).	FBiH Government, Concession Commission, FMAWMF, cantons, municipalities	2013	Existence of adequate regulatory framework	
				Subtotal 2.2.2	1,400,000.00
				Total 2	5,780,000.00

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
INSTITUTIONAL FRAMEWORK FOR WATER MANAGEMENT					
3	Efficient institutional organization and administration capable of implementing accession process and application of EU requirements in water sector				
3.1.	<i>Institutional strengthening of water sector in the Federation of BiH</i>				
3.1.1.	Professional strengthening of FMAWMF	FMAWMF	by 2014	Professional staffing and representation in accordance with the job systematization of the Ministry and requirements deriving from application of FWD requirements and other EU Directives	
3.1.1.1.	Inciting development and training of institutions providing professional support to FMAWMF, as well as cantonal ministries, within the scope of their responsibility	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	Medium-term until 2014 along with continuation of activities until 2021	Multidisciplinary established and staffed institutions providing support to FMAWMF.	
3.1.1.2.	Institutional and professional strengthening of utility companies within the area of water management and sanitation	Competent cantonal ministries, municipalities, public utility companies	2009-2021 as continuous activity	Efficient and staffed institutions (within cantons, municipalities and utility companies) responsible for areas of water supply and sanitation	
3.1.1.3.	Establishment and training of teams for managing and implementing water sector projects – PPÜ (Programming and Planning Unit)	FMAWMF, competent cantonal ministries, municipalities	2011	Organisationally established and institutionally linked project management and implementation teams	
3.1.1.4.	Development of central database on the status of quality of surface and ground waters with reporting obligation towards all public institutions as well as registered polluters	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2010-2021 as continuous activity	Annual Report on the status of water protection	
3.1.1.5.					

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
3.1.1.6.	Establishment of cooperation among different management structures regarding reporting obligation on the status of waters and water management in BiH Federation, upon the requests of international commissions, to relevant institutions at the level of BiH.	Directorate for European Integrations, Inter-ethnicity Water Commission, BiH Ministry of Foreign Trade and Economic Relations, FHMI	2012 and continually until 2021	Report on implemented activities and contributions to the work of international commissions	
3.1.1.7.	Establishment and staffing of Cantonal Inspection Offices	FBiH Government, Federal and Cantonal Inspection Offices	2009	Institutionally established and staffed Federal and Cantonal inspection offices	
3.1.1.8.	Establishment of advisory councils for Sava River Basin District and Adriatic River Basin District	FBiH Government	2009	Establishment of advisory council in accordance with the FBiH Law on Water (Article 164)	
Subtotal 3.1.1					6,000,000.00
3.1.2.	Capacity building				
3.1.2.1.	Increase of multidisciplinary representation in water sector institutions	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, cantonal ministries of agriculture, water management and forestry	2014	Professional staffing of water sector institutions capable of implementing activities in line with the WFD requests and other Directives	
3.1.2.2.	Mandatory and continuous vocational training of water sector staff	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, cantonal ministries of agriculture, water management and forestry	2009-2021 as continuous activity	Implemented annual plans of staff training	
3.1.2.3.	Organisation and implementation of training for larger industrial polluters – participation of water management sector representatives	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2009-2021 as continuous activity	Implemented training programmes for industrial polluters	
Subtotal 3.1.2					2,600,000.00

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
3.1.3.	<i>Intensifying cooperation with other sectors associated with waters</i>				
3.1.3.1.	Intensifying intersectoral cooperation	FBiH Government, FMAWMF, FMET, FMJP, FMEMI, and competent cantonal ministries	2009-2021 as continuous activity	Activities on planning and realization of specific measures by individual sectors (energy, spatial planning, environment) are implemented based on intersectoral cooperation.	
3.1.3.2.	Promoting principle of integrated water management in other sectors.	FMAWMF, FMET, FMEMI, cantonal ministries of agriculture, water management and forestry	2009-2021 as continuous activity	In their activities, environment, energy and agriculture sector understand and accept principles on which integrated water management is based.	
				Subtotal 3.1.3	500,000.00

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
3.1.4.	<i>Establishing reference and authorized laboratory(ies) for water quality testing</i>				
3.1.4.1.	Development of technical basis for enacting by-laws on terms and conditions and scope of work of reference and authorized laboratory(ies)	FMAWMF, RBDA	2010	Report on adoption of relevant provision	
3.1.4.2.	Designation of reference laboratory(ies) for the territory of BiH Federation by FMAWMF	FMAWMF, RBDA	2011	Report on designation of laboratory	
3.1.4.3.	Designation of and issuance of work authorisations for authorized laboratories and cooperation with inspection services with the aim of accurately establishing the load of pollution	FMAWMF, RBDA, Federal and Cantonal inspection services	2011	Report on the number of laboratories and their level of equipment, and analyses developed for the needs of water sector upon different requests	
				Subtotal 3.1.4	1,850,000.00
3.1.5.	<i>Improvement of alert system and efficient responding in cases of accidental pollutions and water pollution emergencies</i>				
3.1.4.2.	Development of technical basis of a by-law detailing detail out procedures and describing actions in case of accidental pollutions and pollution emergencies	FMET, in cooperation with FMAWMF, RBDA	2012	Drafting and publishing the by-law.	
3.1.4.1.	Strengthened system of inspection supervision over water bodies at which changes have been detected as consequence of natural or damages caused by human negligence, in cooperation with citizens' associations (fishing associations, nature enthusiasts, eco associations and similar)	Federal and Cantonal Inspection Offices, RBDA	2010-2021 as continuous activity	Annual reports on number, type, consequences, sites and similar of occurrences of accidental pollutions and pollution emergencies	
				Subtotal 3.1.5	250,000.00
				Total 3	11,200,000.00

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
USE OF WATERS					
4	Increase in coverage and improvement of public water supply				
4.1.	<i>Increase in coverage of public water supply systems from current 60% to approximately 80% at the end of planned period of the Strategy</i>				
4.1.1.					
4.1.1.1.	Connecting local water supply systems to public water supply systems and their placing under full control	Competent cantonal ministries, municipalities, utility companies	2018	Completed detailed summary of local water supply systems within the objective of "increase of coverage of population by public water supply". Bringing these water supply systems to the status of being technically equipped thus facilitating their subjecting to management by utility companies. Establishment of a system of collection of water charges.	
4.1.1.2.	Extension of coverage of public water supply system towards peripheral areas.	Competent cantonal ministries, municipalities, utility companies	2016	Data on annual changes of percentage of coverage of population by public water supply.	

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
4.1.1.3.	Establishment of group (inter-municipality and regional) water supply systems	FBiH Government, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, competent cantonal ministries, municipalities, utility companies	2009-2021 as continuous activity	Completed establishment of at least one new regional or inter-municipal water supply system based on prior defined or plans adjusted to present conditions. (e.g. Plava Voda regional water supply line, extension of water supply line for Tuzla region).	808,000,000.00
Subtotal 4.1.1					
4.1.2.	<i>Reduction of loss in public water supply systems by approximately 15%</i>				
4.1.2.1.	Replacement of worn out pipes and rehabilitation of worn out facilities in water supply systems	Competent cantonal ministries, municipalities, utility companies	2009-2021 as continuous activity	Periodic reports on the status of water supply networks. (Worn out, and especially asbestos-cement pipes, are replaced in water supply networks. Rehabilitation of worn out water supply line facilities is carried out: water abstraction structures, water treatment facilities, water tanks, pump stations).	
4.1.2.2.	Education of population and industry using drinking water on the need for rationalization of water consumption	Competent cantonal ministries, municipalities, utility companies	2009-2021 as continuous activity	Reports on implementation of public awareness and education programmes for population on the need of rational use of water	
Subtotal 4.1.2					
					280,500,000.00

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
4.1.3.	<i>Rational use, protection, improvement of status and preservation of water resources being used or intended to be used for the needs of public drinking water supply</i>				
4.1.3.1.	Continuous implementation of research works with the aim of protection of the existing and potential water resources from the aspect of their use for water supply needs	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, Competent cantonal ministries, municipalities, utility companies	2009-2021 as continuous activity	Implemented annual plans for execution of research works	
4.1.3.2.	Implementation of technical and administrative source protection measures in accordance with the FBiH Law on Water and by-laws	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, Competent cantonal ministries, municipalities, utility companies	2009-2021 as continuous activity	Prepared reports on protection of drinking water sources in accordance with the rulebook adjusted to FBiH Law on Water. Technical and administrative source protection measures are being implemented.	
				Subtotal 4.1.3	74,000,000.00
4.2.	Provision of conditions for sustainable use of water in areas whose development depends on market interest				
4.2.1.	<i>Preservation of water resources in accordance with the terms and conditions of their use and protection stipulated in the FBiH Law on Water, in line with the expected water demand in the areas whose development depends on the market and general interest</i>				

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
4.2.1.1.	Industry: Incite application of more favourable technological processes in production which provide considerable water saving	FMEMI, in cooperation with FMAWMF and FMET and competent cantonal ministries, Environment Protection Fund of FBH	2009-2021 as continuous activity	Implemented annual plans on application of more favourable technological processes with measurable results of reduction of water consumption.	
4.2.1.2.	Industry: Providing guidelines in development of industry growth plans from the aspect of water management	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, FMEMI	2009-2021 as continuous activity	Developed plans of industry growth in FBiH based on participation of water management sector and based on providing guidelines on use and protection of water	
4.2.1.3.	Energy: Participation in development of plans for construction of hydro-electric power facilities under the conditions set in accordance with the River Basin District Management Plans	FMEMI, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2009-2021 as continuous activity	Activities on planning and implementing energy projects realized with participation of water management sector based on accepted support to development of multipurpose water systems	
4.2.1.4.	Energy: Ensuring participation of water sector in development of studies on exploitability of water power.	FMEMI, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2009-2021 as continuous activity	Studies on use of water power developed under the conditions set by water management sector	
4.2.1.5.	Agriculture: Ensuring participation of water sector in development of agricultural land irrigation study for the territory of FBiH	FMAWMF departments for "water management" and agriculture, Sava RBD Agency and Adriatic Sea RBD Agency	2009-2021 as continuous activity	Study on irrigation of agricultural land in FBiH developed based on conditions of water management sector	

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
4.2.1.6.	Navigation: Ensuring water sector participation in activities on reconstruction and restoration of the existing waterways and inclusion of navigation aspect in multipurpose reservoir development plans	FMTC, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2009-2021 as continuous activity	Reconstruction and restoration of certain waterways carried out with participation of water management sector. Developed plans on multipurpose water systems including navigation aspect	
4.2.1.7.	Fishery: Ensuring water sector participation in preparation of fishery development plans in terms of warmwater and coldwater fish farms as well as development of fish cage farming	FMAWMF – Department for “water management”, competent cantonal ministries, Sava RBD Agency and Adriatic Sea RBD Agency	2009-2021 as continuous activity	Fishing development plans prepared based on conditions set by water management sector	
4.2.1.8.	Sport and recreation: Identification of sites favourable for development of water sports and recreation	FMET, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, FMJP, competent cantonal ministries, municipalities	2009-2021 as continuous activity	Favourable sites for development of water sports and recreation identified with participation and determining of conditions by water management sector	
4.2.1.9.	Sport and recreation: Including the aspect of sport and recreation in plans on construction of multipurpose reservoirs	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, FMET, FMH, FMKS	2009-2021 as continuous activity	Plans on establishing multipurpose water systems – reservoirs prepared on the basis of plans on development of sport and recreational activities	
4.2.1.10.	Mineral and geothermal waters: Continued implementation of research works together with development of plans on long-term use of these waters, with emphasize on multipurpose use	FMEMI, FMAWMF, FMH	2014	Plans on multipurpose use of mineral and geothermal waters prepared with participation of and based on conditions set by water management sector	

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
4.2.1.11.	Mineral and geothermal waters: Development of plans on implementation of measures of protection of these waters	FMEML, FMAWMF	2014	Plans on measures of protection of mineral and geothermal water sources that are used or are planned to be used in planning phase of the Strategy prepared based on cooperation between mining and water management sector.	
				Subtotal 4.2.1	3,500,000.00
				Total 4	1,166,000,000.00

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
5	PROTECTION OF WATERS				
5.1.	Achieving and maintaining good status of surface water and groundwater for the purpose of protection of aquatic flora and fauna and needs of water users				
5.1.1.	Development of Water Management Plan for Sava River Basin District and Adriatic River Basin District				
5.1.1.1.	Development of methodology for designation of surface water body types and characterization of surface and groundwater body types (2011)	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2011	Drafted, adopted and published regulations by FBiH Government in accordance with Article 43 of FBiH Law on Water	
5.1.1.2.	Defining reference conditions for classification of ecological status and permitted limit values of chemical quality parameters for classification of chemical status of surface water bodies				
5.1.1.3.	Defining parameters of quantitative and chemical quality for classification of the status of groundwater bodies				
	Establishment of the quality monitoring system of surface and groundwater which will derive from the Monitoring Programme				
5.1.1.4.	(Under Annex V of Water Framework Directive: Development of monitoring of surface and groundwater according to the adopted Plans: Monitoring of ecological status and chemical status of surface waters and Monitoring of chemical status of groundwater)	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2014	Annual report with all quantified and descriptive data	
5.1.1.5.	Drafting and publication of official record on content and manner of adoption of Water Management Plan – Working Plan for preparation of Water Management Plan	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2010		
5.1.1.6.	Development of Water Management Plan according to elements laid down by the FBiH Law on Water including Programme of Measures		2015		
				Subtotal 5.1.1	24,060,000.00

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
5.1.2.	<i>Reduction of pollution from urban/sanitary waste waters</i>				
5.1.2.1.	Adoption of decisions on the manner of collecting, draining and treatment of waste waters in accordance with the FBiH Law on Water, Article 54	Cantons and municipalities	2011	Report on municipalities which have adopted the decision	
5.1.2.2.	Increase of the degree of coverage of population with sewerage systems and construction of appropriate facilities for waste water treatment	Canton, municipality, city, public utility companies; in cooperation with FMAWMF and agencies	2018 as first phase, deadline 2023	Number of population covered according to official records	
	Settlement of 2000 – 10000 p.e.		2023	70% - 197,500 inhabitants	
	Settlement of 10000 – 15000 p.e.		2023	75% - 125,000 inhabitants	
	Settlement of over 15000 p.e.		2018	90% - 917,000 inhabitants	
			TOTAL:	1,239,500 inhabitants	
5.1.2.3.	Development of guidelines and guidebooks as support in selection and standardization of the appropriate technologies of urban waste water treatment and sludge processing, harmonized with the requirements of effluent quality according to the rulebooks in effect.	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2010.	Publishing conclusions and expert presentations	
5.1.2.4.	Periodic evaluation of results of the implemented measures and further research aimed at providing better and more accurate grounds for decision-making.	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2014-2021 as periodic activity	Publishing conclusions and expert presentations	
				Subtotal 5.1.2	703,505,000.00
5.1.3.	<i>Reduction of emission of hazardous and toxic substances produced by individual industrial polluters through establishing permitted emission system and polluter pays principle</i>				
5.1.3.1.	Establishment and maintenance of a register of industrial polluters	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, in cooperation with FMEIM and FMET, Federal and Cantonal Inspection Offices	2010-2021 as continuous activity	Register of industrial polluters established with regular periodic revisions	

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
5.1.3.2.	Efficient issuance of prior water authorisations with in aim of issuing environmental permits	FMAWMF, FMET, Sava RBD Agency and Adriatic Sea RBD Agency and competent cantonal ministries	2010-2021 as continuous activity	Number and type of water deeds related to issuing environmental permits	
5.1.3.3.	Establishment of a system of continuous monitoring of effluents from polluters and strengthening control monitoring by water managing organizations	FMEMI, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency and polluters	2010-2021 as continuous activity	Number of established systems of monitoring of production of pollution entering into waters of industrial polluters	
Subtotal 5.1.3					500,000.00
5.1.4.	<i>Reduction of quantity of pollution that reaches surface water and groundwater from regulated and unregulated solid waste landfills</i>				
5.1.4.1.	Priority removal of unregulated waste landfills and waste disposal sites from zones that have negative impact on surface water and groundwater.	Municipality, city, canton, industrial polluters in cooperation with FMET and FMAWMF	2015	Degree of completion and date of the last data update.	Funds planned by Environmental Protection Strategy
5.1.4.2.	Rehabilitation of the existing and construction of new solid waste landfills according to the Waste Disposal Strategy and plans which will be developed in accordance with the European Directives in effect	Municipality, city, canton, industrial polluters in cooperation with FMET and FMAWMF	Continuous activity 2021	Degree of coverage by organized system of collection and final disposition of waste	
5.1.4.3.	Development of capacities for adequate collection and disposal of mining and industrial waste	Mines and industrial polluters in cooperation with FMET and FMAWMF	Continuous activity 2021	Number and type of industrial and mining facilities covered by organized system	
Subtotal 5.1.4					0

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
5.1.5.	<i>Reduction of pollution from agricultural activities</i>				
5.1.5.1.	Quantification of pollution load from agricultural activities in areas with its noticeable impact through establishment of an appropriate monitoring and control system	FMAWMF, Sava RBD Agency, Adriatic Sea RBD Agency	2010-2021 continuous activity	Defined number and size of areas covered by monitoring	
5.1.5.2.	Water sector participation in development of FBiH agro-environmental programme as part of the integral land management system with emphasize on water protection	FMAWMF, Sava RBD Agency, Adriatic Sea RBD Agency	2011	Intersectoral reporting	
5.1.5.3.	Application of principles of good agricultural practice through implementation of action plans and guidebooks which contain measures pertaining to sustainable use of manure and protection substances	Government of BiH Federation, FMAWMF – cooperation between department for “water management” and agriculture	2010-2021 as continuous activity	Periodic intersectoral reporting during implementation	
				Subtotal 5.1.5	320,000.00
5.1.6.	<i>Reduction of pollution from activities related to forest management</i>				
5.1.6.1.	Participation in adoption of forest management plans as planning documents which contain the manner of usage of forest resources/space in areas of mutual interest to water users and forest management bodies	FMAWMF, competent cantonal ministries, Sava RBD Agency, Adriatic Sea RBD Agency	2010-2021 as continuous activity	Overview of the existing forest management plans	
5.1.6.2.	Carrying out multidisciplinary surveys aimed at determining effects of forest management to qualitative – quantitative water regime	FMAWMF, competent cantonal ministries Sava RBD Agency and Adriatic Sea RBD Agency	2010-2021 as continuous activity	Number of surveys carried out on this topic	
				Subtotal 5.1.6	250,000.00

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
5.1.7.	Construction of waste water collection, drainage and treatment systems for settlements of less than 2,000 inhabitants				
5.1.7.1.	Launching and implementation of pilot projects with the aim of identifying acceptable technologies for smaller settlements	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, in cooperation with municipalities, Federal Fund for Environmental Protection	2012	Publishing results of Pilot Project(s)	
5.1.7.2.	Development of guidelines, definition of norms and construction of sewerage systems and facilities for waste water treatment for around 25% of population living in settlements of up to 2,000 inhabitants	Cantons and municipalities in cooperation with FMAWMF, RBDA	2010-2021 as continuous activity	Report on the degree of implementation and number of population covered	
Total: 338,000 – inhabitants					
Subtotal 5.1.7					186,150,000.00
5.1.8.	Reduction of pollution from traffic				
5.1.8.1.	Survey of effects of pollution from all types of traffic	FMAWMF, RBDA, in cooperation with FMTC and FMET	2012 and continuously in 2012-2021	Published results of specific surveys with monitoring indicators	
5.1.8.2.	Elaboration of procedures in the process of issuing environmental permits along with ensuring participation of water sector representatives through efficient issuance of water authorisation approvals for reconstruction of the existing and construction of new roads	FMAWMF, RBDA, in cooperation with FMTC and FMET	2010-2021 as continuous activity	Number of issued environmental permits / water deeds	
Subtotal 5.1.8					220,000.00
5.1.9.	Designation of protected areas in line with FBiH Law on Water				
5.1.9.1.	Technical and administrative designation of zones of sanitary protection of drinking water sources of public and local water supply systems whose capacity exceeds 10 m ³ /day.	Municipalities, cities, cantons, FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2010-2021 as continuous activity	Number of covered water supply lines – reporting on annual level	

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
5.1.9.2.	Development of technical basis and adoption of decisions on designation of areas intended for protection of economically important aquatic species in accordance with the existing regulations	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, FMET	2010-2021 as continuous activity	Annual level reporting on number of protected areas	
5.1.9.3.	Development of technical basis and adoption of decisions on designation of areas intended for water sport and recreation	FMAWMF, FMET, RBDA, FMJP, FMH	2010-2021 as continuous activity	Annual level reporting with status assessment	
5.1.9.4.	Development of technical basis and adoption of decisions on designation of areas sensitive to nutrients and appropriate monitoring programme	FMAWMF - Department for "water management" and agriculture	2010-2021 as continuous activity	Annual reporting with number of areas sensitive to nutrients	
5.1.9.5.	Development of technical basis and adoption of decisions on designation of protected areas related to habitats of aquatic and semi-aquatic plant and animal species	FMAWMF, RBDA, FMET	2010-2021 as continuous activity	Annual level reporting on number of protected areas	
5.1.9.6.	Setting up a database on the status of surface water and groundwater bodies by river basin districts and its integration into the WIS	FMAWMF, RBDA	2010-2021 as continuous activity	Annual level reporting on	
				Subtotal 5.1.9	37,685,000.00
				Total 5	952,690,000.00

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
PROTECTION AGAINST WATERS					
6	Reduction of the risks at extreme hydrological phenomena				
6.1.	<i>Reconstruction and rehabilitation of the existing and construction and maintenance of the system of protection facilities with the aim of increasing the safety level in terms of protection against floods</i>				
6.1.1.	Reconstruction of the existing flood protection facilities up to the necessary level of protection corresponding to the importance of defended area and scope of damage which could be inflicted by potential high water flood of specific grade of the phenomena	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, competent cantonal ministries, municipalities	2010-2021 as continuous activity	Periodic reports on status of facilities for protection against water	
6.1.1.1.	Construction of protection structures against high waters in endangered areas by priorities				
6.1.1.2.	Ensuring functionality of the existing protection structures against adverse effects of water				
6.1.1.3.	Providing support to planning and establishing multipurpose water systems (where effects of these structures are manifested on a wider area and greater number of important economic and other facilities) in cooperation with primarily the energy, agriculture and spatial planning sectors				
6.1.1.4.	Facilitate coordinated activities of water and agriculture sector for the purpose of revitalization of the existing melioration systems and facilitation of their development in accordance with the plans and needs of agricultural consumers as well as the needs for protection of settlements against adverse effects of inland waters				
6.1.1.5.		FMAWMF, cantons, municipalities and other land proprietors	2010-2021 as continuous activity	Periodic reports on the level of revitalization of the existing melioration systems	
				Subtotal 6.1.1	535,500,000.00

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
6.1.2.	<i>Development and adoption of plans for protection against adverse effects of water</i>				
6.1.2.1	Development and implementation of operational flood and ice defence plans	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, competent cantonal ministries, Federal and Cantonal Administration for Civil Protection, FHMI	2010-2021 as continuous activity	Periodic reports on the level of implementation of operational plans	
6.1.2.2.	Development of preliminary assessment of flood risk, map of threats and map of flood risks as well as flood risk management plans: ²⁸⁹	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency		Maps and Plans developed, presented and adopted	
	Preliminary assessment of flood risk		2013		
	Maps of threat and flood risks		2015		
	Flood risk management plans		2017		
	Revision of flood risk management plans		(2023)		
6.1.2.3.	Establishment of a database (within the water information system - WIS) and flexible monitoring system with the aim of submitting data on water levels, flow rates and precipitation. Establishment of the model of forecast of flow rate and reservoir management. Defining the manner of information and warning.	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, FMEMI, public enterprise J.P. Elektroprivreda BiH d.d. Sarajevo, public enterprise J.P. Elektroprivreda HZHB d.d. Mostar, FHMI	2010-2021 as continuous activity	Report on monitoring system status. Developed instructions for information and warning.	
6.1.2.4.	Coordinating work of specialized services (meteorological, users of reservoirs, spatial planners, protection and rescue services), as well as units of local self-government, farmers, environmental scientist, foresters, non-governmental organizations, entrepreneurs, citizens and media	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, FMEMI, cantons, municipalities and civil protection	2010-2021 as continuous activity	Report on status and level of coordination regarding water management at potentially endangered areas	
				Subtotal 6.1.2	60,500,000.00

²⁸⁹ Regulation on type and contents of plans for protection against adverse effects of water (Official Gazette of Federation of BiH, No. 26/09 dated 15 April 2009)

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
6.1.3.	<i>Reduction of erosion</i>				
6.1.3.1.	Development of Erosion Protection Programme	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, FMET, FMJP	2012	Developed Erosion Protection Strategy and Programme. Report on anti-erosion measures and mitigation of damages	
6.1.3.2.	Implementation of general anti-erosion measures which implies: legislative measures; innovation of erosion map; monitoring of erosion processes; education of population; integration of erosion protection issues into spatial and forest management plans	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency, competent cantonal ministries, municipalities	2010-2021 as continuous activity		
6.1.3.3.	Mitigation of damages caused by erosion	FMAWMF Sava RBD Agency and Adriatic Sea RBD Agency, competent cantonal ministries, municipalities	2010-2021 as continuous activity		
				Subtotal 6.1.3	23,000,000.00
6.1.4.	<i>Establishment of Programme for Combating Drought</i>				
6.1.4.1.	Involvement in EU activities related to water shortage	FMAWMF, Sava RBD Agency and Adriatic Sea RBD Agency	2010-2021 as continuous activity	Plans of activities in water shortage situations prepared based on participation of water management sector	1,500,000.00
				Subtotal 6.1.4	

Table 5.1. Measures implementation plan for fulfilling water management objectives

No.	Objectives and measures by areas	Institutions responsible for implementation of measures	Planned timeline for implementation of measures	Parameters for assessment of success of implementation of measures	Needed investments (KM)
6.1.5.	<i>Prevention and preparedness in case of disaster – dam demolition or overflow</i>				
6.1.5.1.	Development of periodic Studies on status and stability of the existing facilities in function as well as preparation of the Study on effects of flood wave (primary and secondary) on people and material assets in flood-prone area	FMEMI, owners, users	2010-2021 as continuous activity	Report on enforcement of regulation	
6.1.5.2.	Development of the Study on early warning of people of flood wave threat, i.e. flood, installation of automatic measurement stations and water level detectors on all larger watercourses and downstream from dams	FMEMI, owners, users	2010-2021 as continuous activity		
				Subtotal 6.1.5	500,000.00
				Total 6	621,000,000.00
				GRAND TOTAL:	2,760,695,000.00

Overview of Acronyms:	
FMA WMF	Federal Ministry of Agriculture, Water Management and Forestry
FMET	Federal Ministry of Environment and Tourism
FMPP	Federal Ministry of Physical Planning
FMES	Federal Ministry of Education and Science
FMH	Federal Ministry of Health
FMTC	Federal Ministry of Transport and Communications
FMEMI	Federal Ministry of Energy, Mining and Industry
FMF	Federal Ministry of Finances
FMI	Federal Ministry of Justice
FHMI	Federal Hydrometeorological Institute Sarajevo
The Sava RBD Agency	The Sava River Basin District Agency, Sarajevo
The Adriatic Sea RBD Agency	The Adriatic Sea Basin District Agency, Mostar
	www.fmpvs.gov.ba
	www.fmoit.gov.ba
	www.fmpu.gov.ba
	www.fmon.gov.ba
	www.fmpz.gov.ba
	www.fmpik.gov.ba
	www.fmeri.gov.ba
	www.fmf.gov.ba
	www.fmp.gov.ba
	www.fhmzbih.ba
	www.voda.ba
	www.jadran.ba

5.2. Overview of the Required Investments – Costs of the Implementation of the Planned Measures

The costs of the implementation of the planned measures are shown in Table 5.1 above by main area of activity in the water sector: water use, water protection and protection against water, and the legal and economic area of action and strengthening of the institutional framework for water management.

The total amount of funds required to achieve the water management objectives for the next planning period specified in the Strategy is **KM 2,760,695,000²⁹⁰**. The breakdown of these funds by area of activity in the water management sector is as follows: (i) water use: **KM 1,166,000,000**; (ii) water protection: **KM 952,690,000**; (iii) protection against water: **KM 621,000,000**, and the implementation of measures related to the institutional arrangements and strengthening the water sector in the Federation of BiH: **KM 11,200,000**. To implement the measures defined in the legal and economic activity framework over the above-mentioned period, it will be required **KM 4,025,000** and **KM 5,780,000**, respectively.

5.2.1. Legal, Institutional and Economic Activity Framework

The activities planned in accordance with the strategic objectives: (i) Water sector legal and institutional reform, arising from the need to adapt to new social circumstances, along with the EU alignment in the water management sector, as a part of process of BiH stabilization and association to EU, (ii) Adequate integration of water management sector in economic system as a whole, with larger representation of the economic tools in the process of water resources management, (iii) Improving efficiency, transparency and accountability in water management, (iv) Provision of financial viability in water management and reform of water pricing system along with progressive introduction of economic water price, require financial assets to the amount of KM 9,805,000.

To accomplish the strategic objective related to the institutional framework: Efficient institutional organization and administration capable of implementing the accession process and implementation of EU requirements in the water sector – KM 11,200,000 will be required.

5.2.2. Water Use

The accomplishment of the two strategic objectives in this area: (i) Increase in coverage and improvement of public water supply systems, and (ii) Ensuring conditions for sustainable use of water in the areas whose development depends on market interest, requires the amount of 1.166 billion KM, which equals 1,320 KM/inhabitant unit costs, taking into consideration the projected increase in the population by approximately 883.000 in the areas covered with the public water supply systems.

²⁹⁰ The costs of maintenance of the existing facilities and those that are projected in this Strategy are included in the above-mentioned investment value related to the area of protection against water, while the costs related to the areas of water use and water protection are planned to be covered from the service charges.

5.2.3. Water Protection

In this area, the achievement of the following objective has been planned: (i) Achieving and maintaining good status of surface water and groundwater for the purpose of protection of aquatic flora and fauna and needs of water users, and it will require funds to the amount of 952.69 million KM. In relation to the projected population that will inhabit the area covered with the expanded sewerage and waste water treatment systems (1,577,500), the unit cost for this investment amounts to 604 KM/inhabitant.

5.2.4. Protection against Water

The achievement of the strategic objective: “Reducing the risk at extreme hydrological phenomena”, and implementation of the measures to achieve the operational objectives: (i) Reconstruction and rehabilitation of existing, and construction and maintenance of protection facilities for the purpose of increasing the safety level in terms of flood control; (ii) Development and adoption of Plans for protection against adverse effects of water; (iii) Reduction of erosions; (iv) Setting out Programmes to combat droughts, (v) Prevention and preparedness in case of disaster, such as dam demolition or overflow, involves the investments amounting to 621 million KM.

5.2.5. Time Schedule for the Investments over the Strategy Planning Period

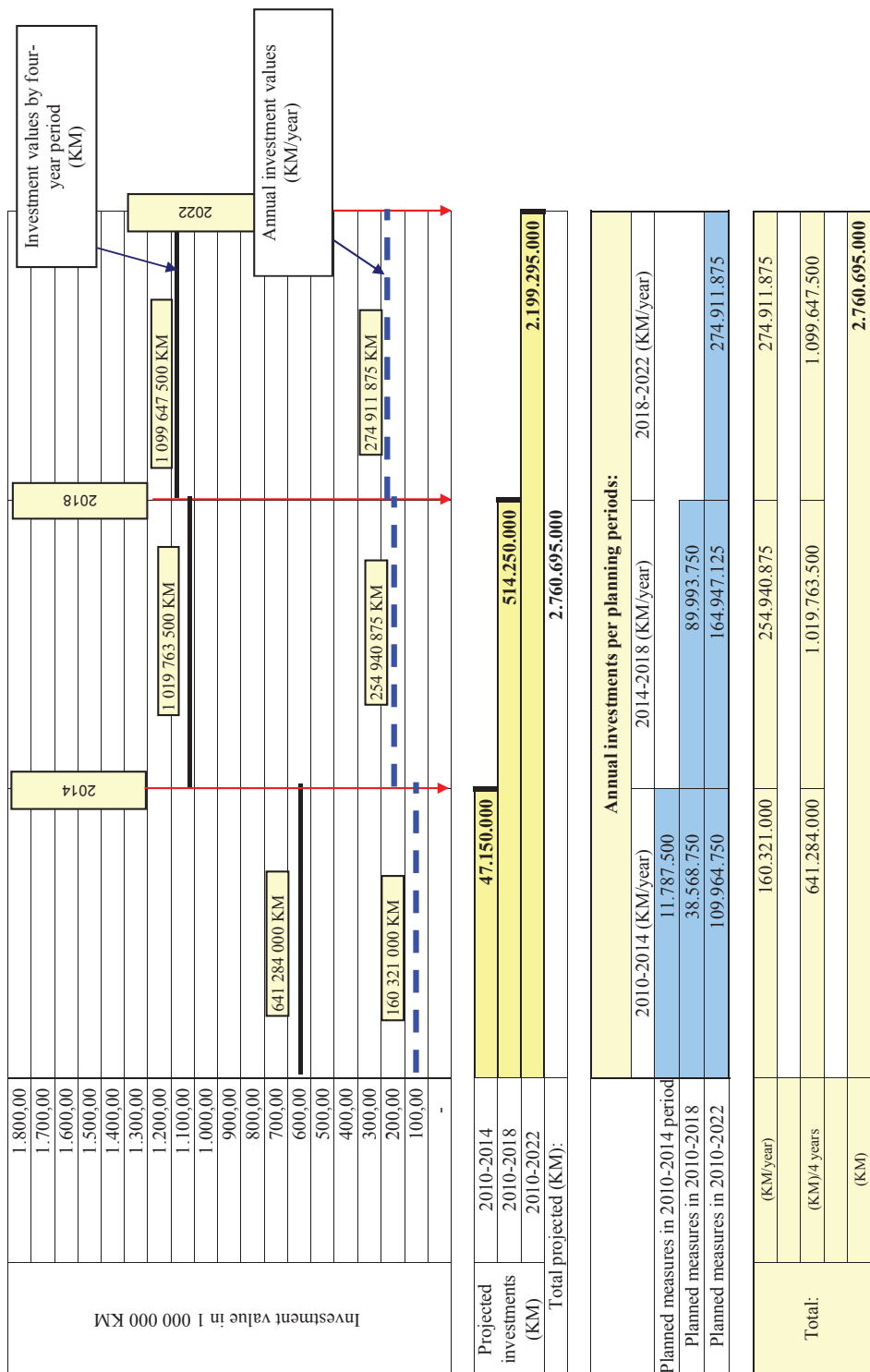
The time schedule over the Strategy planning period of 12 years has been developed on the basis of the deadlines set for implementation of individual measures that by and large depend on the EU Association Process and the requirements of the acknowledged SAA signed between Bosnia and Herzegovina and the European Union. The Strategy planning period is, in this case, divided into three four-year periods for the intended implementation of the investment measures: 2010-2014, 2014-2018 and 2018-2022. The following funds are required over the above-mentioned periods:

▪ 2010-2014	KM 641,284,000	23%
▪ 2014-2018	KM 1,019,763,500	37%
▪ 2018-2022	KM 1,099,647,500	40%
Total:	KM 2,760,695,000	100%

As shown above, in the first quarter, it will be necessary to realize approximately 23% of the funds, meaning that this is a period over which the majority of the institutional and legal framework measures should be implemented, as well as some of the measures falling under the areas of water use, water protection and protection against water that involve the relevant research work and development of the investment and technical documentation. The following two quarters involve full achievement of the objectives set in the areas of water use, water protection and protection against water, which will require considerable investment of 37% and 40% of the total investment, respectively.

The time schedule for the investments in the Strategy planning period is illustrated in Figure 5.2.1.

Time Schedule for Investments in the Planning Period of the Water Management Strategy of FBiH



5.2.6. Assessment of the Potential Sources of Funds and the Funding Conditions for the Implementation of Measures to Accomplish the Objectives set out in the Water Management Strategy of FBiH

In the law on Waters of the Federation of BiH, Article 168, the sources of funds for implementation of the activities and tasks defined in this Law are listed as follows: (i) general water charges; (ii) special water charges (SWC); (iii) revenue generated by lease of the public water property; (iv) the Federation, cantonal, town and municipal budgets; (v) credit funds; (vi) funds provided for in special legislation; (vii) donations and other funds in accordance with the law.

In terms of other sources of funds, under the Law, the revenues generated by concessions on the basis of charges collected for water resources use will certainly represent a very important category.²⁹¹ The revenue generated by concessions is allocated to municipalities, cantons and the Federation in certain proportions.²⁹² These funds may also be allocated for funding water projects focused on implementation of the objectives and tasks falling under the competences of the municipalities, cantons of the Federation. Awarding concessions in accordance with BOT (Build-Operate-Transfer) approach in the water sector involves construction, reconstruction and funding of the entire facility, device or plant, its utilization and transfer after the expiry of the agreed term. In addition to the BOT approach, for funding of the projects requiring long periods of pay-back and large discrepancies in projections, the combined funding, so-called Public Private Partnership (PPP) approach can be used and this approach involves shared investment and risk of the public sector and the private capital.

Certainly, in addition to these, considerable funds for covering the projected expenditures in the water management sector are the revenues generated by providing services to the direct users of the facilities intended for use and protection of waters against pollution.

The approximate amount collected on the basis of the *general water charges* annually in the Federation of BiH totals around 12.6 million KM. In terms of the Strategy planning period of 12 years, this amounts to approximately 150 million KM. (Distribution: the Water Agencies - 40% or 60 million KM; the Cantonal Budgets - 45% or 67.5 million KM and the Environment Protection Fund of the Federation of BiH - 15% or 22.5 million KM). Out of this amount, the realistically available funds for financing the above-mentioned needs in the water management sector total **approximately 132 million KM**, as follows: the Water Agencies – 42 million KM, the Cantonal budgets – 67.5 million KM and Environment Protection Fund of the Federation of BiH 22.5 million KM. (The balance of 18 million KM represents the costs of labour and operations, as well as the operating reserves of the Water Agencies to the amount of approximately 30% of the total funds generated by collection of water charges).

The approximate amount collected on the basis of the *special water charges* (SWC) annually in the Federation of BiH totals around 31.7 million KM. In terms of the Strategy planning period of 12

²⁹¹ The Laws regulating the area of concessions in BiH are as follows: (i) Law on Concessions of BiH ("Official Gazette of BiH ", No. 32/02); (ii) Law on Concessions of the Federation of BiH ("Official Gazette of FBiH", No. 40/02) and the Cantonal laws on concessions.

²⁹² On the 46th session of the Government of the Federation of BiH, which was held in Sarajevo on 21 February 2008, the Government tasked the Federal Ministry of Agriculture, Water Management and Forestry to instigate amicable amending of the Concession Agreements so that they are adjusted to the form and content prescribed by the Law on Concessions and the Rules for Determining the Concession Charges. The companies that use water within their business activities, including those that use water to generate electric power are, in the Government's opinion, obliged to conclude the Concession Agreements in accordance with the Law on Concession, and to pay certain concession charges that will be subsequently determined by the competent Ministry. The initiative to conclude these Agreements should be made by the Commission for the concessions falling under the FBiH competence.

years, this amounts to approximately 380 million KM, provided that the collection rate is 100%²⁹³. Distribution: the Water Agencies - 40% or 152 million KM; the Cantonal Budgets - 45% or 171 million KM; Environment Protection Fund of the Federation of BiH - 15% or 57 million KM). The realistically available funds for financing the above-mentioned needs in the water management sector total **approximately 335 million KM**, as follows: the Water Agencies - 107 million KM; the Cantonal Budgets – 171 million KM; the Environment Protection Fund of the Federation of BiH - 57 million KM. (The balance of 45 million KM represents the costs of labour and operations, as well as the operating reserves of the Water Agencies to the amount of approximately 30% of the total funds generated by collection of water charges).

Within the total amount of **467 million KM**, the realistically available funds to cover the expenditures stipulated in this Strategy that are generated by the collection of water charges, over the planning period of 12 years, are divided as follows:

- i. Water Agencies - **149 million KM**;
- ii. Cantonal Budgets - **238.5 million KM**;
- iii. Environment Protection Fund of the Federation of BiH – **79.5 million KM**.

The use of revenues generated by collection of the water charges is stipulated in Article 178 of the Law on Waters, specifying the purposes for which the funds may be used by the River Basin District Agencies (primarily, the protection of waters); the Cantonal budgets (water supply, water protection and protection against water); and the Environment Protection Fund of the Federation of BiH (primarily, for co-funding the water protection infrastructure of relevance for the Federation of BiH).

The text below provides an approximate structure for the three major areas of activity in the water sector: water use, water protection and protection against water.

- The funds required in the area of **water use** to the total projected amount of *KM 1.166.000.000* would be approximately provided from the following sources:

WATER USE		
Cantonal budges (KM)	212.300.000 (18,2%)	(other budgetary revenues)
Federation BiH Budget	133.500.000 (11,4%)	
Public Utility Company funds (KM)	230.000.000 (19,7%)	
Municipalities (KM)	40.200.000 (3,5%)	(through the Budges or by issuing municipal bonds)
Int. Financial Institutions (KM)	550.000.000 (47,2%)	(loans and Pre-Accession Assistance funds of EU)
TOTAL (KM):	1.166.000.000	

²⁹³ The collection rate should be significantly increased following the amendments of the Law on Tax Administration according to which the Tax Administration Office would be responsible for collection of the general and the special water charges.

- The funds required in the area of **water protection** to the total projected amount of **KM 952.690.000** would be approximately provided from the following sources:

WATER PROTECTION		
Cantonal budges (KM)	88.490.000 (9,3%)	(from the revenues generated by collection of water charges)
Cantonal budges (KM)	100.000.000 (10,5%)	(other budgetary revenues)
FBiH Environ. Protection Fund(KM)	79.500.000 (8,3%)	
FBiH Budget (KM)	150.000.000 (15,7%)	
Public Utility Company funds (KM)	100.000.000 (10,5%)	
Municipalities (KM)	60.000.000 (6,3%)	(through the Budges or by issuing municipal bonds)
International Financ. Institutions (KM)	374.700.000 (39,4%)	(loans and Pre-Accession Assistance funds of EU)
TOTAL (KM):	952.690.000	

- The funds required in the area of **protection against water** to the total projected amount of **KM 621.000.000** would be approximately provided from the following sources:

PROTECTION AGAINST WATER		
River Basin Districts Agencies (KM)	149.000.000 (24%)	(from the revenues generated by collection of water charges)
Cantonal budges (KM)	150.000.000 (24,2%)	(from the revenues generated by collection of water charges)
Cantonal budges (KM)	150.000.000 (24,2%)	(other budgetary revenues)
FBiH Budget (KM)	100.000.000 (16,1%)	
Privatization proceeds (KM)	40.000.000 (6,4%)	
Municipalities (KM)	32.000.000 (5,1%)	(through the Budges or municipal bonds)
TOTAL (KM):	621.000.000	

Recapitulation of potential financial sources is presented in following table:

RECAPITULATION		(KM)	(%)
1	Cantonal budges from the revenues generated by collection of water charges	238,490,000	8.7
2	Cantonal budges from the revenues generated by other budgetary revenues	462,300,000	16.9
3	FBiH Budget	383,500,000	14.0
4	Public Utility Company funds	330,000,000	12.0
5	Municipalities	132,200,000	4.8
6	Water Agencies	149,000,000	5.4
7	Privatization proceeds	40,000,000	1.5
8	International Financ. Institutions	924,700,000	33.8
9	Environemnt protection fund of FBiH	79,500,000	2.9
TOTAL:		2,739,690,000	100.00

Table 5.2.6.1. Recapitulation of potential sources for covering planned expences of measures realization of Strategy of Water management according to base scopes of water management activities (water use, water quality protection and protection against water)²⁹⁴

If the total funds would be equally distributed over the 12-year Strategy Planning period, it would be required approximately 230 Mio KM at average each year. However, the Strategy offers other options in terms of the investment time schedule that would not be linear. The current total amount of the allocated funds in the water sector annually cannot be precisely estimated. The reason for this is primarily because it is impossible to provide a full insight into the overall data related to the

²⁹⁴ Needed amount for conduction of measurements for legal, economy and institutional activities, 21.005.000 KM, will be ensured from budget sources of Federation of BiH

allocations made by all promoters in the water sector (the data related to the river basin district agencies are mainly those that are available), as well as because of the variable loan debit in different years, which makes the calculation of a characteristic or average value of these allocations on an annual basis more difficult. Nevertheless, it is assessed that the necessary allocations in the future period will be considerably higher compared to previous years.

Such a trend is justified by some assumptions, as follows: an increased rate of special water charges collection (due to the anticipated involvement of the Tax Administration Office), the introduction of general water charges, the anticipated introduction of economic water prices and increase in the revenues generated by the public water supply companies, the anticipated increase in some water use charges, the new opportunities in terms of funding (e.g. issuing local/municipal bonds), the anticipated larger participation of the private sector through the arrangements of public-private partnership, etc.

The progressive introduction of the “economic water price” should enable the companies dealing with water supply and the collection and treatment of waste water to cover a considerable portion of the investment costs, after covering their own operating costs. The missing funds would be primarily covered from the Cantonal Budgets and the Environment Protection Fund, as well as from the municipal budgets (solely for treatment, i.e. water protection).

Subsequently, a portion of the expenditures would be covered from private funds through different forms of private and public partnership, the funds generated by concession contracts and municipal shares.

The remaining part of the required funds is likely to be provided from the loans extended by international financial institutions, and due to realization of Pre-Accession Funds of EU.

The following text is an overview of the major sources of credit funds, i.e. major financial institutions in Bosnia and Herzegovina. Their previous engagement in the water management sector, if any, is very concisely described below. This overview includes also the specific requirements for granting loans and, where possible, the total available funds were assessed. The most important potential sources of credit funds in the Federation of BiH, which can be counted on in the future in terms of the water sector, are as follows:

- WB – World Bank – Country Office Bosnia and Herzegovina,
- European Union Funds: EBRD – European Bank for Reconstruction and Development, EIB – European Investment Bank, KfW – Entwicklungsbank,
- BOR – BiH Reconstruction and Development Bank.

5.2.6.1. World Bank

The World Bank Country Office Bosnia and Herzegovina (BiH) is one of the most important potential sources of credit funds. The active portfolios of the World Bank projects in BiH (there are several of them related to water management sector) are as follows: (i) Community Development Project finances the priority local infrastructure projects (including water supply) in under-served municipalities across the country; (ii) The Urban Infrastructure and Service Delivery Project; (iii) The Water Quality Protection Project is related to the protection of the Rivers Neretva and Bosna through reducing pollution; (iv) Neretva and Trebišnjica Management Project, and The River Sava Navigability Project, which is also in its preparatory stage, as well as Irrigation Project.

5.2.6.2. European Union Funds

The European Union is, certainly, one of the potential sources of funds. The major potential sources are divided into two groups: IPA and IPF funds. The text below is a brief overview of these funds:

- **Instrument for Pre-Accession Assistance (IPA)**²⁹⁵ **2007-2013** supports the candidate countries and potential candidate countries in:
 - Fulfilling the pre-accession criteria (political, economic, and *Acquis* membership criteria) through building administrative and judicial capacities,
 - Preparing for management (programming and implementing) of the accession funds of the European Union (Cohesion fund, structural funds and Rural Development Fund).

The EU relationships with the candidate countries and the potential candidate countries in the Western Balkans region are governed by the Stabilisation and Association Agreements or the perspective of their conclusion. The Governments of these countries are required to get involved in the process of the IPA implementation, starting from the IPA's multiannual planning stage. IPA consists of the following five components: (i) Transition Assistance and Institution Building, (ii) Cross Border Cooperation, (iii) Regional Development, (iv) Human Resources Development and (v) Rural Development.

- **Multi Annual Indicative Planning Document - MIPD** is a strategic document for IPA and in case of Bosnia and Herzegovina, it covers Component I and Component II. MIPD is established for a three year rolling period, with mandatory annual reviews. MIPD represents the standpoint of the Commission regarding the main areas of intervention and the top priorities that a beneficiary country should develop in detail within its national programme documents, as well as within the sectoral policies and strategies. For the purpose of harmonizing the needs and priorities of Bosnia and Herzegovina with the needs and priorities of MIPD, the European Commission provides the process of consultations with the state authorities that are administered by the Directorate for European Integration on behalf of BiH.

The other type of EU funds is so-called **IPF Fund (Infrastructure Project Facility)** worth 32 million Euros, for the entire region (mostly the countries of the former Yugoslavia and Albania). The decisions on fund allocations are made directly in Brussels.²⁹⁶

The EU funds in the form of IPF will be operative through the following banks that are part of so-called IFIs Group (International Financial Institutions):

- **EBRD (European Bank for Reconstruction and Development)** provides funds exclusively on the principle of project financing. In its portfolio, the Bank refers to the water sector as municipal infrastructure (water supply, drainage and treatment of waste water). The Project financing means that the end-user of the loan must be capable of repaying the loan on a realistic

²⁹⁵ For the purpose of EU perspective development for the Western Balkan countries, an Instrument for Pre-Accession Assistance – IPA was created under the Directive of the EC Council No. 1085/2006 dated 17 July 2006. According to this programme, Bosnia and Herzegovina is in the group of potential candidate countries, together with Albania, Montenegro and Serbia. IPA provides financial aid through a single and synchronized tool to the countries with clear European perspective, whose ultimate goal is to enter the EU.

²⁹⁶ The banks from the IFI group extend the loans for environmental projects through the Infrastructure Project Facility. IFI EU funds are matched with the credit funds, meaning that by withdrawing the smaller amount of funds through IPF, the significantly larger loans are approved by these banks. In 2009, the IPF funds were practically allocated from the IPA funds, and in this year, 40 million Euros was allocated for Bosnia and Herzegovina only (for three sectors: environment, transport and SMEs)

economic basis (from economic tariffs), and not by subsidizing. The projects must include transitional or reform component to be funded – they must introduce economically-based tariffs i.e. prices for their services. The minimum amount of an individual loan is 5 million Euros. Sovereign loan is such a loan under which the State of Bosnia and Herzegovina is the principal borrower and the funds are then transferred to the end-users of the loan. In such cases, the loan conditions include EURIBOR plus 1%, while in all other cases these conditions are less favourable (EURIBOR plus 2 to 3 %) due to a higher risk (namely, cantons and municipalities can directly receive a loan). The local share in the sovereign loan arrangements consists of paying all liabilities arising from VAT, as well as the costs related to land expropriation, if any, within the relevant project. The main condition for receiving the loan is that the project promotes sustainable development in the sense that the Bank does not require the loan to be repaid from the budget, but that the end-users of the loan (e.g. municipal public water supply companies), as a result of implementation of the economic prices charged for their services, become capable of repaying the borrowed funds. Only in such a manner and under such conditions, the Bank accomplishes its mission outlined back in 1990, that its projects must contribute to the sectoral reform or transition for the purpose of steering the sectoral operations towards the market economies. In terms of the total amount of funds, it is not specified by sector, and therefore the water sector can request considerable borrowings, under the above-mentioned conditions. In terms of the projects in the area of protection against adverse effects of water, due to the fact that it is not possible to precisely identify the end-user of the funds under the above-mentioned conditions (i.e. that the reform component must be in place), the Bank is not willing to fund the projects in this area.

- KfW Entwicklungsbank acts on behalf of the German Federal Ministry for Economic Cooperation and Development.²⁹⁷ The funds for financing water projects are provided by the German Government. Since KfW covers the energy sector as well, the funds for water sector have been allocated, practically, every other year, to the amount of 10 million Euros. The funding conditions for water projects are that the project must be proposed by the State of BiH (the entities delegate the projects to the State) with local participation, meaning that the cost share of the relevant municipalities is 20% of the project value. Therefore, in the upcoming ten-year period, the available credit funds from this source will amount from 40 to 50 million Euros. (KfW is mentioned in this context because it can access the EU funds through IPF).

5.2.6.3. EIB (European Investment Bank)

(Agreement on Funding between Bosnia and Herzegovina and the Federation of Bosnia and Herzegovina and the European Investment Bank (EIB) – Water-Supply and Sewerage Project in the Federation of Bosnia and Herzegovina).

The Agreement with the European Investment Bank that is related to the financing and development of the water-supply and sewerage systems in the municipalities of the Federation of BiH is 60 million Euros worth agreement, while the total value of the project itself is 121 million Euros. The Project is funded under the standard conditions offered by the European Investment Bank (EIB). The reimbursement period is 25 years, with 6 year grace period and market interest rate. These projects are related to around 15 municipalities in the Federation of BiH that have been nominated for receiving the funds, however, it is also open for other municipalities should they decide to use these funds.

²⁹⁷ In Bosnia and Herzegovina, this Bank has already been engaged in the water supply projects and the project related to waste water collection in four municipalities (Bihać, Kakanj, Derventa and Kostajica), while the project of construction of the waste water treatment plant in Bihać is in its preparatory stage.

5.2.6.4. BiH Development Bank – BOR Bank

Loan conditions: maximum amount of an individual loan is 1.5 million KM; maximum reimbursement period is 8 years; interest rate is 8% per annum; required cost sharing by the borrower is 30%. The total available funds in the upcoming ten-year period are around 20 to 30 million KM. The cantons and municipalities can directly apply for the credit funds.

