

*in cooperation with the*



# Sub-Basin Level Flood Action Plan

## - Sava River Basin -



November, 2009

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## 1. INTRODUCTION

In response to the danger of flooding and in line with its Joint Action Programme, the ICPDR decided in 2000 to establish the long-term Action Programme for Sustainable Flood Prevention in the Danube River Basin. The whole process was accelerated after disastrous floods in 2002 and resulted in adoption of the Action Programme at the ICPDR Ministerial Meeting on 13 December 2004.

The overall goal of the ICPDR Action Programme is to achieve a long term and sustainable approach for managing the risks of floods to protect human life and property, while encouraging conservation and improvement of water related ecosystems. Given the area, the complexity and the internal differences in the Danube River Basin, the Action Programme represents an overall framework, which needs to be specified in further detail for sub-basins. Therefore, the targets of the ICPDR Action Programme include preparation of flood action plans for all sub-basins in the Danube catchment area.

In September 2007 a Directive of the European parliament and of the Council on the assessment and management of flood risks (EFD) was adopted by the European Council. The aim of the Directive is to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity. The Directive requires Member States to first carry out a preliminary flood risk assessment by 2011 to identify areas at risk of flooding. For such areas they would then need to draw up flood risk maps by 2013 and establish flood risk management plans focused on prevention, protection and preparedness by 2015.

As the ICPDR Action Programme was designed in full coherence with EFD the flood action plans for sub-basins are an important part of implementation of the EFD and they summarize the key actions towards preparation of the flood risk management plans. Therefore, the preparation of the flood action plans for sub-basins can be considered as an interim step in implementation of EFD.

This action plan for the Sava River sub-basin reviews the current situation in flood protection and sets the targets and the respective measures aiming among others to reduction of damage risks and flood levels, increasing the awareness of flooding and to improvement of flood forecasting. The targets and measures are based on the regulation of land use and spatial planning, increase of retention and detention capacities, technical flood defences, preventive actions, capacity building, awareness & preparedness raising and prevention and mitigation of water pollution due to floods.

This Action plan has been derived from Action plans prepared by Bosnia&Herzegovina, Croatia, Serbia and Slovenia, contracting Parties to the Framework Agreement on the Sava River Basin (FASRB). In preparation of this common FAP, the recent documents dealing with the flood related issues prepared under umbrella of the Sava Commission were also taken into account.

It is foreseen that this planning document could be further refined as appropriate and necessary by the Sava Commission.

## **2. CHARACTERISATION OF CURRENT SITUATION**

As the largest by discharge and the third longest tributary to the Danube, on its way from the spring in Slovenian Alps until its mouth to the Danube River in Belgrade, the Sava River connects the four states: Slovenia, Croatia, Bosnia&Herzegovina and Serbia. The large complex of preserved alluvial wetlands in the middle of the basin, called Central Posavina makes the Sava River Basin unique for the outstanding biological and landscape diversity, as well as for a good functioning flood retention system.

In the times of the Socialist Federal Republic of Yugoslavia, when the Sava River has been the biggest national river, the efforts have been made to treat the water management in the Sava River Basin in an integrated manner. Nowadays, Sava River is an international river and the four countries, signatories to the Framework Agreement on the Sava River Basin (FASRB), are promoting a coordinated sustainable flood protection on the Sava River basin level. The flood risk management is considered as a part of integrated river basin management, basing on the Directive 2007/60/EC (Directive on the assessment and management of flood risks, hereinafter „Flood Directive”) and taking into account the Action Programme on Sustainable Flood Protection in the Danube River Basin, adopted in 2004. Both documents suggest common approaches to the flood risk management, coordinated planning and action within river basins and sub-basins, while considering the interests of all the partners involved.

### **2.1. Topography**

The Sava River Basin is a major drainage basin of the South Eastern Europe covering the total area of 97,713. km<sup>2</sup>. Geographically, it spreads between 13.67°E and 20.58°E longitude and between 42.43°N and 46.52°N latitude, and represents one of the most significant sub-basins of the Danube River Basin, with the share of 12%.

The Sava River basin area is shared between five countries: Slovenia, Croatia, Bosnia and Herzegovina, Montenegro and Serbia, while a negligible part of the basin area also extends to Albania.

Terrain in the Sava River basin is very variable. It significantly changes from the source of the Sava River on the west to its confluence with the Danube River at the east.

In the upper part of the Sava River basin which belongs to Slovenia, rugged mountains (the Alps and the Dinarides) mostly covered by forests prevail.

In the middle and downstream parts of the basin, there is a remarkable distinction in landscape of the northern part (the left bank) and the southern part of the basin (the right bank). While the areas drained by the right tributaries in the middle and the lower section of the Sava watercourse are also rugged, draining numerous rivers running from the Dinaric Mountains in Croatia, Bosnia, and lower from Serbia and Montenegro, with mountain peaks up to 2,500 m a.s.l. that are characterized by green and often forested plateaus, the north, left tributaries cross lowland areas, characterized by flat plains and low mountains. This area is part of Pannonian Plain, a low-lying, fertile, agricultural region.

Generally, elevation of the Sava River Basin varies between approx. 71 m a.s.l. at the mouth of the Sava River in Belgrade (Serbia) and 2,864 m a.s.l. (Triglav, Slovenian Alps). Mean elevation of the basin is 545 m a.s.l.

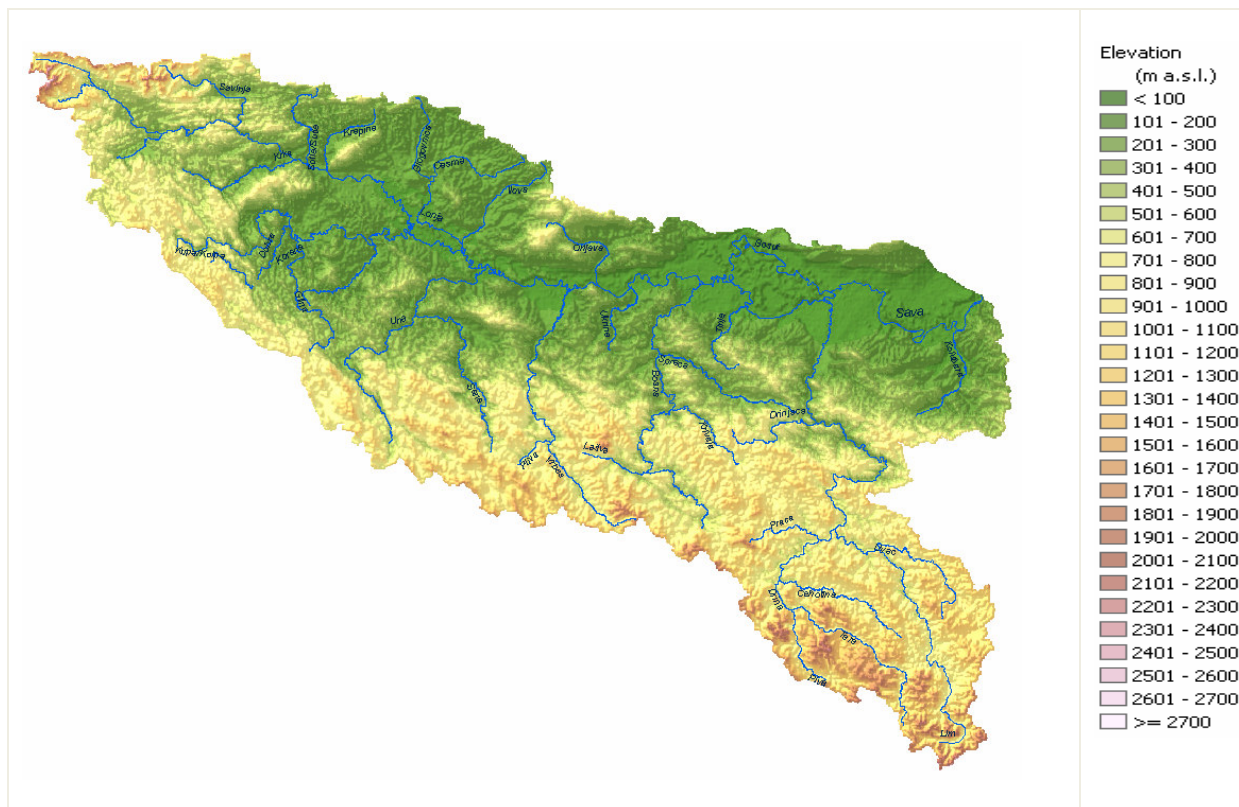


Figure 1: Sava River Basin relief characteristics

Land Class	%
Artificial surfaces	2.23
Agricultural areas	42.36
Forests and semi natural areas	54.71
Wetland	0.08
Inland water	0.63

Table 1: Distribution of main land cover classes in the Sava River Basin<sup>1</sup>

## 2.2. Climate and Hydrology

The Sava River catchment is situated within a wide region where the moderate climate of the northern hemisphere prevails. The cold and hot seasons are clearly distinctive. The winter can be severe with abundant snowfalls, while summer is hot and long.

<sup>1</sup> According to the Corine land cover database (CLC 2000)

Climate conditions within the basin can be classified into three general types:

- Alpine climate;
- Moderate continental climate;
- Moderate continental (mid-European) climate.

**Alpine climate** is prevailing in the upper Sava River basin within Slovenia, **moderate continental climate** dominates in right tributaries' catchments within Croatia, Bosnia and Herzegovina and Montenegro and **moderate continental (mid-European) climate** primarily features in the left tributaries' catchments that belong to the Pannonian basin.

Dividing lines between these three categories are not sharp, due to different degree of influence of various factors that determine the climate. Most significant factors that cause climatic modifications in the Sava River catchment are orographic features that reflect upon most important climatic events: air temperature and precipitation and indirectly upon evapotranspiration.

Average **annual air temperature** for the whole Sava River basin was estimated to about 9.5 °C. Mean monthly temperature in January falls to about -1.5 °C, whilst in July it reaches almost 20 °C.

Average **annual rainfall** over the Sava River basin is estimated at about 1,100 mm. **Precipitation** amount and its within-the-year distribution are very variable within the basin, and it ranges from 650 in the lowlands to 1000 in the higher altitudes, up to 4000 mm/y in the highest mountains. While in Slovenian part of the Sava River basin, the most precipitation occurs in summer season or during autumn, the long periods with snow cover result with relatively high spring- to early summer runoffs, in the Pannonian part the most precipitation occurs in the warmer part of the year. Snowfall is a regular feature every year all over the whole Sava River basin.

The following mean annual precipitation map<sup>2</sup> illustrates the spatial variability of precipitation in the basin

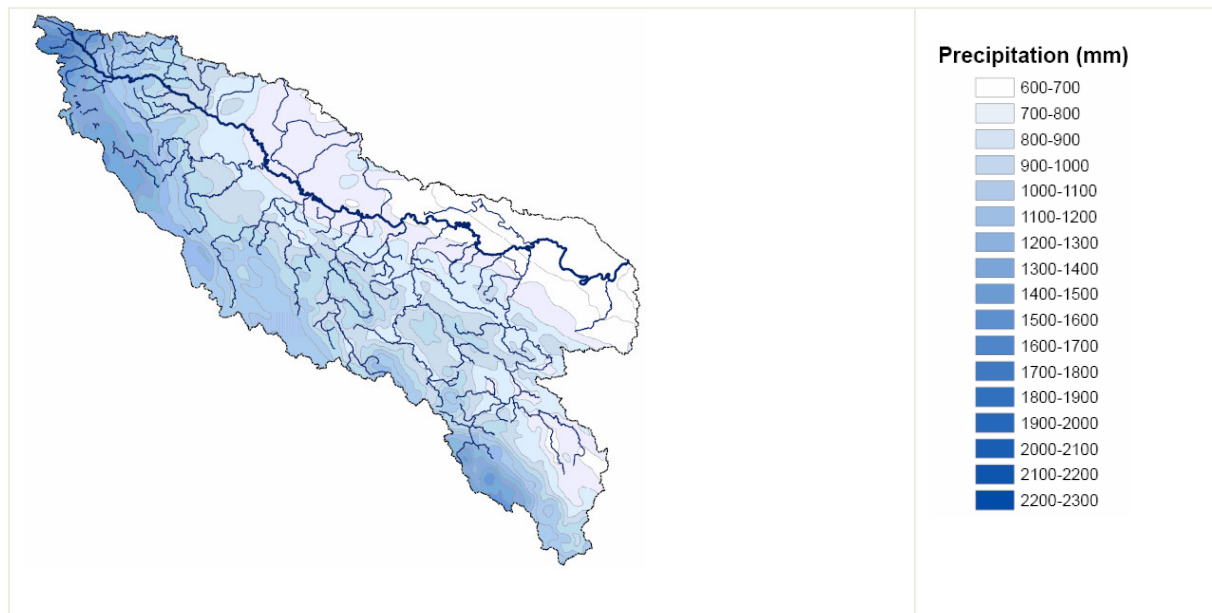


Figure 2: Mean annual precipitation in the Sava River Basin

<sup>2</sup> Source: *The Danube and its Basin – Hydrological Monograph, Vol. VIII, International Hydrological Programme of UNESCO and Water Research Institute Bratislava, Slovakia, 2006*

The *long-term average discharge* of the Sava River at the mouth near Belgrade is about 1,600 m<sup>3</sup>/s. This is equivalent to the effective rainfall of about 570 mm/year and the corresponding long-term average unit-area-runoff for the complete catchment of about 18 l/s km<sup>2</sup>.

Torrential nature (steep channel's slope, high water velocity and rapids) characterize the most important Sava tributaries in the upper Sava River basin in Slovenia, as well as all other mountainous zones in other parts of the Sava River basin. Thus, besides the tributaries in Slovenia, the largest precipitation and highest water yield take place in the upper catchments from the right tributaries: Krka, Kupa, Una, Vrbas, Bosna and the Drina River, as the largest Sava tributary. The left tributaries: Sutla, Krapina, Lonja, Ilova, Orłjava and Bosut River, as well as the right tributaries Ukrina, Tinja and Kolubara River, due to less rainfall, are characterized with a low water yield (up to 12 l/s km<sup>2</sup>).

In the Table 2, hydrological data for the main hydrometric stations on the Sava River are presented. The data source is the Hydrological Study of the Sava River – 1976, (Sava Project Coordinating Board, Zagreb and Institute for Water Management “Jaroslav Černi“, Belgrade, 1976). This was the last harmonized data on the basin –wide level, performed in the former Yugoslavia, before the Sava River became a transboundary river.

<b>Gauge station</b>	<b>Chainage</b> km	<b>Catch. Area F</b> km <sup>2</sup>	<b>sQs</b> m <sup>3</sup> /s	<b>Q<sub>1%</sub></b> m <sup>3</sup> /s
Radovljica	857.7	904	49.0	1047
Litija	777.7	4829	178.1	1965
Radeče	743.6	7103	229.7	2982
Zagreb	702.8	12450	327.0	3143
Crnac	599.3	22832	557.0	2540
Jasenovac	525.2	38953	799.0	2633
Mačkovac	458.7	40038	828.0	3156
Sl. Kobaš	409.0	49031	1001.0	3441
Sl. Brod	378.0	50858	1020.0	3905
Županja	271.9	62891	1209.0	4527
Sr. Mitrovica	139.0	88434	1600.0	6753

Table 2: Main hydrometric stations on the Sava River (*Hydrological Study of the Sava River – 1976, 1976*)



Based on the results of several important hydrological studies prepared for the Sava River Basin, floods in the Sava Basin usually appear in the spring and in the autumn. Spring floods are the result of snow melting, while autumn floods are caused by heavy rainfall.

### 2.3. Floodplains and flood defences

#### 2.3.1. Floodplains

There are 44 mayor floodplains<sup>3</sup> (protected and unprotected) along the Sava River and along the most downstream sections of its 1<sup>st</sup> order tributaries, with the total area of 5759<sup>4</sup> km<sup>2</sup>.

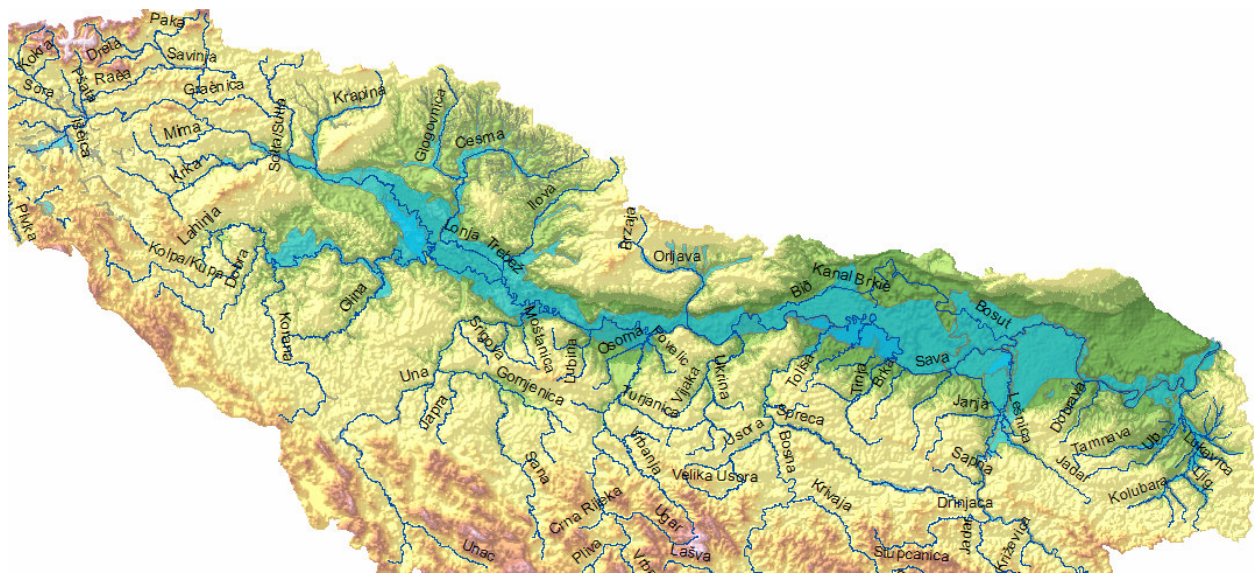


Figure 3: Major floodplains in the Sava River Basin

Important flood prone areas of the right transboundary tributaries of the Sava River (Kupa, Glina, Korana, Una and Drina River) cover 705 km<sup>2</sup>. On the left side of the Sava River valley, besides the Bosut River, there is only one flood prone area on a transboundary river –Sutla/Sotla River, with a total area of 16 km<sup>2</sup>.

#### 2.3.2. Flood defences

Historically, the protection against floods in **Slovenia** was mainly performed through a regulation of watercourses, by increasing the cross-section of the channel and building bypass channels, dikes, detention and retention reservoirs. Majority of dikes was built along the Sava River near Krško, Brežice and Čatež, along the Savinja River above the town of Celje, and for local flood protection on some short sections along the Sava River and its tributaries Savinja, Mirna, Sevnica, Kamniška Bistrica, Sotla River and others. The dikes were made through time with different designed level of protection. Retention and

<sup>3</sup> Source: Sava River Basin Analysis- Annex II: Flood management in the Sava River Basin

<sup>4</sup>In this area also the whole floodplain area along the tributary Bosut River is included

detention reservoirs were designed for flood reduction, mostly on smaller rivers, with volume capacity from a few thousand to a few million of cubic meters for improvement of a local flood protection. Volume reserved for flood reduction in these reservoirs is about 25 million m<sup>3</sup>. Construction of hydropower stations on lower section of the Sava River in **Slovenia** involved maintenance, restoration, improvement and construction of new structural flood defences (dikes, detention reservoirs) for flood protection of existing settlements.

The existing protection systems in the Sava River Basin in **Croatia** are very complex and comprise of a large number of regulative and protective water structures. Along national watercourses there are around 1600 km of protective dikes, whereas local watercourses are protected by around 200 km of different protective structures. In cooperation with various water and land users, multipurpose reservoirs were constructed with the total volume of 73 hm<sup>3</sup> and mountain retention storages with the total volume of 2,5 hm<sup>3</sup>; partially also 5 large lowland retention storages in the Sava River basin (Lonjsko polje, Mokro polje, Zelenik, Kupčina, and Jantak) with the total volume of 1.590 hm<sup>3</sup>, which have, together with the system of relief canals (three main: Odra, Lonja - Strug and Kupa – Kupa), a large positive impact on the flood regime as in Croatia, so in the downstream countries. Currently, the only city adequately defended from the Sava River flooding is the City of Zagreb, which is estimated safe from floods of a 1.000-year return period. On the other hand, Zagreb is protected from Mt. Medvednica torrential streams only from floods of 20 to 50-year return periods. The other areas along the Sava River are generally insufficiently protected. Upstream of Zagreb, towards the Slovenian border, protective dikes have not yet been erected, what causes frequent flooding of several settlements in the lower area of wider Zaprešić and Samobor region. Downstream of Zagreb, all the way to the border with Serbia, many areas along the Sava River have a lower protection level than the required flood of a 100-year return period, due to the fact that the existing dikes are not high enough, or are in many places of inadequate quality.

Constructed flood protection systems along the Sava River in **Bosnia and Herzegovina** consist of Sava River dikes and dikes along the Sava River tributaries in lower (flood prone) part of the course. Flood zones were formed in polders, so called "kasete" which are independently protected against floods. The total length of the Sava River dikes is 202.85 km. Regulatory level of protection is generally for 1 %-annual-chance flood event, but some sections of the dikes need reconstruction in order to provide adequate defence. Furthermore, war damages on the flood defence structures are not completely repaired yet. Protection against external upland waters and inland waters is provided by 19 pump stations in total capacity of 136.4 m<sup>3</sup>/s. For collecting the external (upland drainage waters) system of main boundary canals was constructed in total length 223.24 km, and for collecting inland waters in the zone of the Sava River protected area, a main canal network has been constructed of 230.2 km length in total. Total protected area in the Sava River system is covering 919.9 km<sup>2</sup>. There are also the sections without flood protection and they present inundation zones along the Sava River, thus still remaining with a (limited) natural function of accepting and transforming part of the flood wave volume. Basically, inundation zones are accepting Sava River flood waters, so its retention capacity is relatively small.

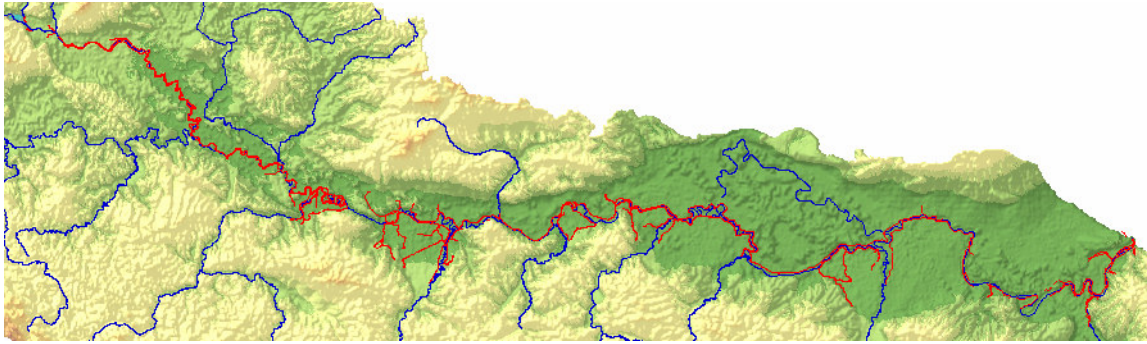


Figure 4: Levee system along the Sava River

The history of development of the flood protection system along the Sava River in **Serbia** is very long, and related to establishment of numerous settlements and agricultural development. The levee reconstruction to so called “Sava levee profile” was initiated after extremely difficult and expensive flood defences in 1974 and 1981. Reconstructed levees within the backwater zone of the “Iron Gate 1” HPP have ballast on the protected side. However, reconstruction of the flood defence lines along the Sava River and its tributaries in the mouth sections has not been completed so far. The left-bank dikes of the Sava River protect the lowland area of Srem. The defence line is discontinuous, with three different sectors: 1<sup>st</sup> from r.km 0 to km 56, 2<sup>nd</sup> from r.km 56 to km 135.2 and 3<sup>rd</sup> from r.km132.2 to km 209.8. The reconstruction in the 1<sup>st</sup> sector has not been completed yet. Only two short stretches of the 2nd sector are protected. The natural reserve “Obedska bara” is situated in this area. All levees in the 3<sup>rd</sup> sector (from Sremska Mitrovica to the border with Croatia) are reconstructed and ensure suitable safety level.

The defence line along the right bank of the Sava River is also characterized with three different sectors: 1<sup>st</sup> from r.km 0 to km 55.1, 2<sup>nd</sup> from r.km 70.3 to km 101.8 and 3<sup>rd</sup> from r.km 101.8 to km 168. Flood protection line is interrupted by numerous smaller and larger tributaries and generally required safety level is not provided in the central Belgrade zone. In the 2<sup>nd</sup> section (Skela-Šabac) only short dikes are built to protect agricultural land and small settlements. In the 3<sup>rd</sup> section (Šabac – Drina River mouth) only about 50% of levees were reconstructed, while the rest are below required safety level. Numerous sluices and pumping stations are weak points in flood defence system

### 2.3.3. Flood Defence on the Transboundary Tributaries of the Sava River

The right side transboundary tributaries to the Sava River are: Kupa/Kolpa River, Una River and Drina River. On the left side of the Sava River basin, the transboundary rivers are Sutla/Sotla River and Bosut River.

#### **Sotla/Sutla River**

Sutla River is a transboundary River between Slovenia (77%) and Croatia (23%). In the upstream part of the Sotla/Sutla River, a multipurpose reservoir Vonarje (Sutlansko jezero) has been constructed. From the total reservoir capacity of 12.4 hm<sup>3</sup>, 3.7 hm<sup>3</sup> are reserved for the needs of the flood defence. The reservoir controls 109 km<sup>2</sup> of the catchment, what significantly increases the safety degree against floods of the downstream region.

According to the fact, that the reservoir has never been used for water supply, it has always been just in function of flood defence. The reservoir is today under the Slovenian water management.

In the rest of the catchment, smaller flood protection works have been completed. The total length of the Sotla/Sutla River in Croatia is 4.1 km and the total length of the protection levees is 3.7 km.

The Sotla/Sutla River valey is estimated to be protected from the flood of 10- to 25-years return period.

## **Kupa/Kolpa River**

The Kupa/Kolpa River basin stretches over the three countries: Croatia (82%), Slovenia (11%) and Bosnia&Herzegovina (7%). The flood defence of Karlovac town and the downstream section of the Kolpa/Kupa River is a constituent part of the integral flood defence system of Central Posavina (Kupa River sub-system), that has been described under the chapter 2.3.2.

On the rest part of the Kupa River basin, mostly the training and protection works of minor intensity have been conducted, protecting settlements and important roads, but a lot of planned construction works have not been executed. In general, by the present degree of performed works, it may be estimated that the Kupa River basin is protected from the flood of 5- to 50-year return period. Transboundary tributaries of second order in this basin are Glina and Korana River.

## **Una River**

Una River springs in Croatia, but the larger part of the catchment (over 80%) lies in Bosnia&Herzegovina. Training works and protection works in the Una River Basin started in the 50-ies of the last century. The length of the regulated section of the Una River in Croatia is 15 km. Total length of the protection levees is 19.3 km. It is estimated that the Croatian Pounje (Croatian part of Una River Basin) is protected against the flood of 50- to 100-years return period.

In Bosnia&Herzegovina the floodplains along the Una River are protected up to the area where the Sava backwater reaches. Many settlements on the tributaries are not protected

## **Bosut River**

The spring and the most part of the Bosut River basin (80%) lie in Croatia, while its mouths to the Sava River and the rest of the catchment lie on the territory of Serbia. By the construction and reconstruction works on the protection levees, the sluice and the pumping station Bosut on the mouth of the Bosut River into the Sava River, as well as by construction of the lateral canal Biđ polje and the levees along the Biđ River, the lowland part of the Bosut River is protected against floods (floods of the Sava River, as well as upland waters from the Dilj Mountain). The reservoir Grabovo polje is in function of the flood defence from waters, coming from the Fruska Gora Mountain. By construction of several pumping stations, the drainage is provided in the situations when the gravitational drainage is not possible.

The flood protection in the Bosut River basin is estimated to correspond to the flood of 10- to 100-years return period.

## **Drina River**

Drina River is the most significant tributary both, by the catchment area and by flow. The catchment is shared by Montenegro (34%), Albania (1%), Bosnia&Herzegovina (35%) and Serbia (30%). There are many transboundary tributaries of second order in this river basin (Lim, Cehotina, Crni Rzav and Beli Rzav.)

Drina River has, according to the steeper river basin smaller flood prone areas. The flood defence structures along the Drina River and its tributaries were constructed mainly for protection of larger settlements and their significant industrial facilities. Protection of agricultural land is present only at the most downstream section of the Drina River (Mačva region). Standard flood defence structures – levees are present at the most downstream section of the Drina and on some reservoirs. Dams and reservoirs at Drina, Piva, Lim and Uvac River are also part of the flood protection system.

## **2.4. Institutional and legal framework**

### **2.4.1. Slovenia**

Flood risk management in Slovenia is defined by:

- The Water Act (adopted in 2002, amended in 2008)
  - Rules on methodology to define flood risk areas and erosion areas connected to floods and classification of plots into risk classes (adopted in 2007),
  - Decree on conditions and limitations for constructions and activities on flood risk areas (adopted in 2008),
  - Decree on the detailed content and method of drawing up a water management plan (adopted in 2006),
- The Natural and Other Disasters Protection Act (adopted in 2006),
  - Decree on the contents and drawing up of protection and rescue plans (adopted in 2006),
  - Protection and rescue plan in case of floods (adopted in 2004)

The transposition of Flood Directive will be completed in 2009 with the adoption of Regulation on detailed content and mode of preparation of FRMP.

The institutions responsible for flood risk management/defence are:

- Ministry of the Environment and Spatial Planning, Environment directorate, Department of Waters with its Environmental Agency;
- Ministry of Defence, Administration of the Republic of Slovenia for Civil Protection and Disaster Relief and Inspectorate for Protection Against Natural and Other Disasters

National FRM work programme for 2009-2015 will contribute to more operational coordinated tasks in the process of Flood Directive implementation.

On the level of international Danube River Basin the tasks of coordination and preparation of FRMP are based on the Working programme of the EG for Flood Protection. Working programme is based on provisions of Directive 2007/60/EC and is defining common activities and timetables, considering Convention on Cooperation for the Protection and Sustainable Use of the Danube River (1994) and bilateral agreements between the Government of the Republic of Slovenia and Governments of neighbouring countries Republic of Croatia, Republic of Austria and Republic of Hungary.

### **2.4.2. Croatia**

Flood protection in the Republic of Croatia has been regulated under the Water Act and the Water Management Financing Act. The competent bodies for flood protection issues are: the Ministry of Regional Development, Forestry and Water Management, as a state administration body and “Hrvatske vode”, as a state agency.

The roof state-level Water Management document, the implementation of which is provided for under the Water Act, is the Water Management Strategy, which is prepared by Hrvatske vode and adopted by the Croatian Parliament.

Operative flood defence on state waters is conducted according to the State Flood Defence Plan adopted by the Government of the Republic of Croatia, whereas the carrying out of operative flood defence on local waters is based on flood defence plans for catchment areas, which are adopted by county assemblies on the basis of proposals put forward by Hrvatske vode.

On the basis of these plans, operative flood defence on state waters is established in river basin districts, and within those in counties, various sectors and on different sections of watercourses. Operative flood defence on local waters is established in catchment areas, and within those in counties, various sectors and on different sections of watercourses.

In the Sava River Basin operative flood defence is carried out by Hrvatske vode: the Department of Protection against Adverse Effects of Water (Hrvatske vode Head Office), Service for protection against adverse effects of water within the Water Management Department for the Sava River Basin District (Sava WMD), and by the employees of Croatian Water branch offices in the catchment areas -12 water management branch offices (WMBO). The Sava River basin district flood defence center is located in the seat of river basin district in Zagreb. County flood defence centers are located in county seats. Field flood defence centers for river sections and water watchmen areas have also been established. Activities of protection against adverse effects of water in the Sava River Basin are carried out by approximately 100 permanent employees of Hrvatske vode, with the additional 70 persons temporarily employed when necessary. Interventions during operative flood defence are carried out by the Ministry-approved, court-registered legal entities using their own machinery, equipment and skilled labour. Materials and basic tools for operative flood defence are provided by Hrvatske vode.

Operative flood defence in the Sava River Basin is functioning well, what has been confirmed by successful flood water extraction throughout the past years (1990, 1998, and 2005).

### **2.4.3. Bosnia and Herzegovina**

Bosnia and Herzegovina is territorially divided on two entities (Federation of Bosnia and Herzegovina and Republika Srpska) and one district (Brčko District).

Flood risk management in Bosnia and Herzegovina is under the competence of entities, and for the area of Brčko District, under the competence of the Government of Brčko District.

#### *Federation of Bosnia and Herzegovina*

Flood protection in Federation of Bosnia and Herzegovina (FBA) is regulated by the Water Law (completely harmonized with Republika Srpska Water Law and EU WFD), and by appropriate bylaws. In the field of water management, the most important document is "Water Management Strategy", currently in the final phase of preparation. The development of the Spatial Plan of FBA is in progress.

By the Regulation on Flood Defence Plans (Regulation – "Official Gazette of Federation of Bosnia and Herzegovina" No. 26/09) the types, content and methodology of production, procedure of harmonization of Plans for protection against harmful effects of water in FBA have been defined.

For implementation of measures of protection against flood and ice, during direct danger from occurrence of high (flooding) waters, during floods and removal of the consequences of floods, the Operational flood defence plans were defined (Federal Flood Defence Operational Plan and Cantonal Flood Defence Operational Plan).

According to the present organization of flood defence, the Government of FBA, following the Regulation and proposal of Federal minister of agriculture, water management and forestry is making a Decision on the Main Plan for operational measures on flood protection. Institutional set-up for implementation of the above described legal framework is the following:

- Federal Ministry of Agriculture, Water Management and Forestry Sarajevo - as the body competent for the coordination and harmonization in development of the Main Operational Measures Plan and its implementation
- Federal Meteorological Institute Sarajevo - providing the relevant data
- Operational Center for coordination of key activities on flood defence is in the Headquarters of Federal Ministry of Agriculture, Water Management and Forestry Sarajevo;
- Agency for Watershed of the Sava River, Sarajevo - as the organization which performs all operations on flood defence is in the watershed of the Sava River

Flood defence centers are in FBA located in two flooding areas, namely in Orašje and Odžak in the watershed of the Sava River basin.

#### *Republika Srpska*

The main legal instrument which determines the protection against harmful water affects is the Water Law of Republika Srpska. This law is in compliance with the Water Law of FBA and EU WFD, as well as with Flood Risk Directive (*Official Gazette of Republika Srpska, No. 50/06*).

Institutions responsible for the law implementation:

- Ministry of Agriculture, Forestry and Water Management, Banja Luka
- Water Agency for Sava River District RS, Bijeljina
- Republic Office of Civil Protection, Banja Luka

The implementation of Water law and flood protection is enforced also by public utilities for Sava (Gradiška), Sava (Brod), Posavina (Vukosavje), Ušće Bosne (Šamac), Srednja Posavina (Lončari), Semberija (Bijeljina), Drina (Zvornik) and Gornja Bosna (Foča).

Basic planning documents in the field of water management are:

- Spatial Plan of Republika Srpska for period 2005-2015
- Frame Plan of Development of Water Management of Republika Srpska
- Action Plan for Implementation of Frame Plan of Development of Water Management of Republika Srpska
- Strategy of Development of Agriculture of Republika Srpska by the year 2015
- Study of sustainable development of irrigation surfaces in the territory of Republika Srpska
- The development of Strategy of Integral Water Management is under preparation

Furthermore, by the Law on civil protection, measures and activities of the Civil protection Center on prevention and protection of human and capital assets in case of flooding is determined.

Civil protection is managed by the Republic administration of civil protection, directly supervised by the Republika Srpska Government i.e. Republika Srpska Parliament. Implementation is done through regional departments in Banja Luka, Doboj, Bijeljina and Sokolac.

Relevant Ministry of agriculture, forestry and water management determines authorities in charge for flood protection and their responsibilities. Ministry and Republika Srpska Government cover also the expenses of the flood protection costs.

Republic Institutes for hydrometeorology are in charge for: supervision, measuring, collecting and analyzing hydro meteorological data as well as for weather forecasting.

#### *Brčko District*

Protection from harmful effects of waters, in the territory of Brčko District, is conducted in a same way as in Republika Srpska. The basis for conducting of protection from harmful effects of waters is the Statute of Brčko District BA (*Official Gazette of Brčko District BA, No. 03/07*), Law on Public Administration of Brčko District (*Official Gazette of Brčko District BA, No. 19/07*), Law on Government of Brčko District BA (*Official Gazette of Brčko District BA, No. 19/07*) and Water Law (*Official Gazette of the Republika Srpska, No. 10/98*). Protection from water is conducted based on the Main operation plan for flood defence of Brčko District BA, which is adopted every year by the Government of Brčko District.

Actions of defence on harmful effects of water are managed by Civil Protection Headquarters of Brčko District BA. Civil Protection Headquarters is nominated by the Decision of the major of Brčko District BA.

#### **2.4.4. Serbia**

Protection against harmful water effects is regulated by the “Water Law” (*Official Gazette of the Republic of Serbia, 46/91*). The Law arranges proceedings and measures for flood and ice protection, as well as protection from torrents and erosion.

The participants involved in flood defence are:

- Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia – Republic Directorate for Water;
- Public Water Management Companies: “Srbijavode” – Belgrade (in charge for flood protection along the right bank of the Sava River, and the Drina and the Kolubara River basins), “Vode Vojvodine” – Novi Sad (in charge for flood protection along the left bank of the Sava River and the Bosut River) and “Beogradvode” for the territory of the Belgrade city;
- Local water management companies;
- Republic Hydrometeorological Service of Serbia.

Responsibilities of participants are determined in the General Flood Defence Plan and the Annual Plan for Flood Defence. These plans are prepared only for watercourses with the existing flood protection structures. For other areas endangered by floods, local community appoints flood protection measures and proceedings. Also companies whose properties are endangered prepare special flood protection plans.



The flood and ice control actions are organized and carried on in three phases, depending on the hazard degree: preparation, regular and emergency defence. Phases of defence are defined in the Annual Plan for Flood Defence, in relation to the river stage on the adjacent gauging station.

#### **2.4.5. International Sava River Basin Commission**

The Framework Agreement on the Sava River Basin (FASRB), entered into force on December 29, 2004, represents the first multilateral agreement in the region after the agreement on succession. The Parties to the FASRB (Republic of Croatia, Bosnia and Herzegovina, Federal Republic of Yugoslavia (later on Serbia & Montenegro, and then Republic of Serbia) and Republic of Slovenia) agreed to cooperate for sustainable development of the Sava River Basin. One of the three main goals in transboundary cooperation is undertaking measures to *prevent or limit hazards, and reduce and eliminate adverse consequences*, including those from floods, ice hazards, droughts and incidents involving substances hazardous to water.

Since the start of work of the International Sava River Basin Commission in 2006, the sustainable flood protection in the Sava River Basin has been coordinated by the Permanent Expert Group for Flood Protection (PEG FP) on the basin-wide level. The most important document prepared by the PEG FP is the proposal of Protocol on the Flood Protection, which should serve as the ground document for all common activities in the Sava River Basin. By adoption of this Protocol, the riparian countries shall hopefully agree, while taking into account the FASRB, the Directive 2007/60/EC and the Action Programme for Sustainable Flood Protection in the Danube River Basin, on cooperation in:

- a) Preparation of *the Program for Development of the Flood Risk Management Plan in the Sava River Basin*
- b) Undertaking of *the Preliminary Flood Risk Assessment*
- c) Preparation of *the Flood Hazard and Flood Risk Maps*
- d) Development of *the Flood Risk Management Plan in the Sava River Basin*
- e) Establishment of *the Flood Forecasting, Warning and Alarm System in the Sava River Basin*
- f) Exchange of information significant for sustainable flood protection

The Protocol on the Flood Protection has been distributed to the Parties, signatories to the FASRB (Bosnia and Herzegovina, Croatia, Serbia and Slovenia). Adoption and ratification of the Protocol are expected in due course.

### **3. TARGET SETTINGS**

#### **3.1. Slovenia**

With Water Act (adopted in 2002, amended in 2008) Slovenia put legal frame for overall water management within River basin districts, which includes the protection of water, water usage and water engineering as well to ensure protection against the adverse effects of water.

The implementation of the Directive of the European parliament and of the council on the assessment and management of flood risks 2007/60/EC Slovenia made through the amended Water Act and Rules on

methodology to define flood risk areas and erosion areas connected to floods and classification of floods into risk classes.

Further implementation will be done through national FRM working programme for 2009-2015.

### 3.1.1. Regulation on Land Use and Spatial Planning

The goal of FRM is to limit constructions and activities in flood hazard areas, and to reduce the existing flood risk.

The Decree on conditions and limitations for constructions and activities on flood risk areas (adopted in 2008) could be considered as a part of FRMP. The conditions and limitations for constructions and activities on flood hazard areas are based on expert studies made through the uniform methodology defined by the "Rules on methodology to define flood risk areas and erosion areas connected to floods and classification of plots into risk classes" (adopted in 2007). The major impact of this decree is expected in spatial planning, where the planning process should follow the restrictions of the decree. In the process of producing the expert studies through hydrology, the future change of land use and possibly climate can be taken into account.

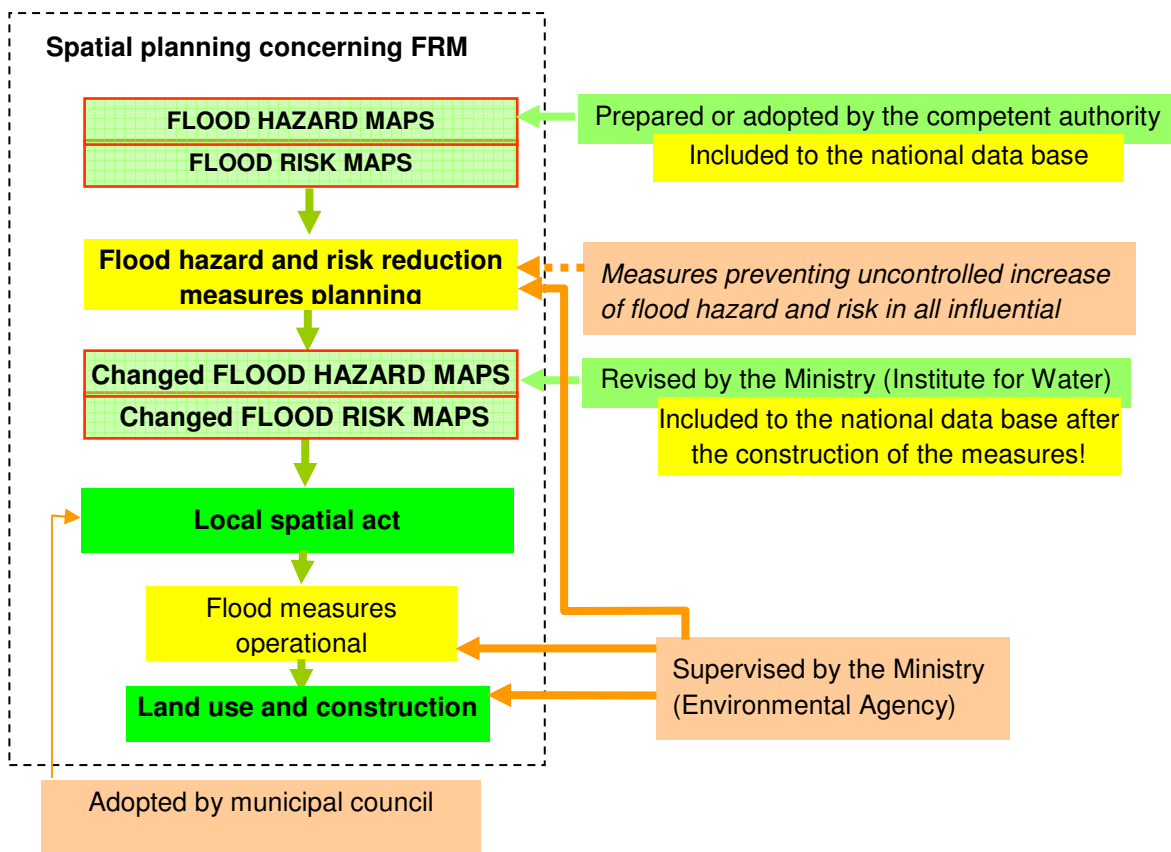


Figure 5: Scheme of spatial planning procedure concerning FRM in Slovenia

The conditions and limitations from Water act that restrict the aggravation of the high water regime due to man-made activities, stimulate the planners to reserve the areas for additional flood retention or other measures to reach the conditions from Water act and to reduce the existing flood risk.

Figure 5 illustrates the spatial planning procedure which takes into account the evaluation of current flood hazard and initial land use limitations for certain class of flood hazard. Adopted legislative allows that in the spatial planning procedures these hazard areas can be intended for certain use, but the procedure has to consider and include measures, which have to be realized or built before the predicted land use can be carried out. Protection measures must take into account the entire river basin area, using the measures to assure flood safety on the area of planning, as well as the measures to prevent flood hazard increase upstream and downstream.

In addition the “Guidance on constructions methods for buildings to increase flood resistance” is in preparation.

The policy to involve the insurance company's policy in flood risk management is in progress.

Also the “user pay principle” and public-private partnership should be increasingly considered in financing the flood protection infrastructure.

### **3.1.2.        Reactivation of former or creation of new retention and detention capacities**

Important issue is preservation of the existing natural retentions, which can be successfully done through environmental issues too, as we know that the biggest diversity of life is in wetlands, intermittent lakes, and other natural places of importance.

The “Decree on conditions and limitations for constructions and activities on flood risk areas” can be considered as a part of FRMP and its implementation can preserve the existing flood hazard areas.

"Rules on methodology to define flood risk areas and erosion areas connected to floods and classification of plots into risk classes" enables defining significant areas of flood and erosion risk and significant ranges of flood and erosion hazards.

The target set in water act that restricts the aggravation of the high water regime due to man-made activities, leads to the solutions which include improvement of efficiency of existing or/and creation of new retention and detention capacities.

Creation of new retention and detention capacities is linked to solutions for reduction of existing flood risk.

Complementary solutions will have precedence where more national objectives can be achieved at the same time. For example, reservoirs can contribute to drought mitigation, flood retention and production of renewable hydro energy at the same time.

### **3.1.3. Technical Flood Defences**

Construction of hydropower stations on lower section of the Sava River in Slovenia involved maintenance, restoration, improvement and the construction of new structural flood defences (dikes, detention reservoirs) for flood protection of existing settlements.

### **3.1.4. Preventive Actions**

For effective reduction of flood risk, the public information on flood issues plays an important role. The Flood indication map is available on the web; flood forecasting and warning is already functioning and still continuously improving.

Flood hazard mapping has started with "Rules on methodology to define flood risk areas and erosion areas connected to floods and classification of plots into risk classes", and the consequences are already reflected on land-use changes through spatial planning with the "Decree on conditions and limitations for constructions and activities on flood risk areas".

Improvements in flood forecasting and warning (forecasting hydrological events and launching flood warnings) are going on through administrative measures (defining the procedures), scientific research (defining the hazard and risk potential) and technical improvements (flood warnings).

### **3.1.5. Capacity Building of Professionals**

The most capacity building for different professions will be done through workshops which are aimed to harmonize the elaboration of hazard and risk maps by the professionals at local level, and are also meant for the administrative professionals who are involved in spatial planning.

### **3.1.6. Raising Awareness and Preparedness of General Public**

The awareness of inhabitants in flood areas is of the crucial importance for reduction of flood risk, so the Flood indication map is already available on the web, flood forecasting and warning is working, while continuously improving.

The public participation in preparation of the flood risk management plans and in decision-making process will be achieved through national FRM Working programme.

The increased awareness of risks should result in more flood insurances and improved building standards, increasing flood resistance of individual building, while allowing every individual to make his home safer.

### **3.1.7. Prevention and Mitigation of Water Pollution Due to Floods**

The "Decree on conditions and limitations for constructions and activities on flood risk areas" defines, for the areas where potential pollution may occur, also the strategic environmental assessment (SEA) and environmental assessment (EA) instruments in planning procedure.

## **3.2. Croatia**

The Water Management Strategy defines the legislative, organizational, financial, technical, scientific-research and IT aspects of water management activities in the present socio-economic circumstances of the accession process of the Republic of Croatia to the European Union, as well as in the future circumstances of full membership.

The conducted analyses of the current condition and developmental needs have shown that Croatia possesses sufficient quantities of water for its own needs, and that water resources, in terms of their quality and quantity, are not a limiting factor of economic development. However, due to marked temporal and spatial unevenness of the water regime, efficient and environmentally friendly water management requires systematic investment in the development and regular maintenance of the functionality of water management systems. Analyses have also shown, that due to partly non-repaired war damage, as well as due to a longer period of insufficient investments in the development and regular maintenance of protective systems, the safety of the population and assets in many potentially flood-exposed areas has been reduced.

Establishment, maintenance and systematic improvements in appropriate preventive protection of the population and resources against floods are just one of the basic tasks of water management and are an essential precondition for further economic development of the country. This assumes achieving economic justifiable levels of protection for the population, material goods and other endangered assets (business premises, thoroughfares, infrastructural systems, agricultural areas, cultural-historical heritage, and so on) along with incentives for preserving and advancing the ecological state of waters and flood areas, in order to create the conditions for further sustainable economic development.

Improvements in flood protection require the application of integrated, systematic, effective and cost-efficient measures together with preventive structural and non- structural activities. The prerequisite for their application is active and coordinated participation of all actors, the water management sector, and of: protection and rescue services, meteorological and hydrological service, health service, physical planning experts, local and regional self-government units, users and managers of multi-purpose water-storage reservoirs, farmers, foresters, environmentalists, scientists and researchers, the media, higher education institutions, interested non-governmental organizations, and citizens and entrepreneurs on the areas potentially at risk.

Preventive flood protection at international river basins is planned through cooperation with competent bodies from other countries in accordance with the provisions of adopted multilateral and bilateral agreements on water management cooperation

### **3.2.1. Regulation on Land Use and Spatial Planning**

It is necessary to bring into balance the demands for further urbanization and economic exploitation of space and land use needs to slow down the run-off and retain water in the basins.

The problems related to water estate will be regulated through the adoption of a regulation harmonized with other regulations related to land use, which will define precise criteria for addressing all controversial issues. The water estate on unregulated inundation areas and on large lowland retarding basins of

protective flood defence systems will be resolved by the zoning of the terrain and graded restrictions in land use. The priority of the water management sector is the demarcation of the water estate, its registration into land registers, and entry into physical plans, and systematic monitoring of the status of the water estate

Target 1. Solve problems related to the water estate in order to prevent inappropriate exploitation of land required for proper functioning of the current water management systems, for their regular economic and technical maintenance, and for their development.

Target 2. Provide information on areas at risk to give input to spatial planning.

### **3.2.2. Reactivation of former, or creation of new, retention and detention capacities**

Maximum flood wave flows, particularly in small- and medium-sized basins, can be partly reduced by preserving and improving the natural retaining capacities of land, watercourses, and floodplains. By implementing such measures, the retained water infiltrates into the ground and is available for future use, favourable water regimes are ensured for water-related ecosystems, at the same time partly reducing extreme flood risks. Natural wetlands and floodplains in the basins therefore need to be preserved, and, where possible and economically justified, reconstructed or extended.

Protection of the banks of watercourses from erosion will, wherever possible, be solved with protective vegetation. The measures based on land development must be neither underestimated nor overestimated, because they usually do not enable sufficient reduction of maximum flows of extreme flood waves, which can be ensured only through the application of various engineering measures. The implementation of renaturalization measures is usually related to high land acquisition costs and the need to provide for back-up employment options because such measures affect mostly agricultural producers. All national programs aimed at improving the status of the environment and its components will be systematically supported. On the areas of large towns urban planners must provide for improved infiltration of storm water into the ground by developing parks and open spaces in new urban settlements. The current sources of pollution on the areas under potential flood risk will be gradually remediated.

Target 1. Preserve and improve retaining capacities

### **3.2.3. Technical Flood Defences**

Safety from floods cannot be achieved without the implementation of structural measures which include regular economic and technical maintenance of watercourses, water estate, and water structures, as well system development works.

From the point of view of health, safety and environment, the priorities of first order in preventive flood protection are the areas of large and larger towns with more than 30,000 inhabitants, potentially at risk from major rivers - the Sava and Kupa River. The priorities of second order are other towns and settlements along the Sava, Kupa and Una River. The current dikes at critical sections along major rivers will be gradually reconstructed and extended. Priority works related to further development of the Srednje Posavlje (Central Posavina) system will be carried out. Other activities will be implemented in the order defined on the basis of various criteria, including: the number of defended population, prevented material and other damage, general water management significance, estimated investment costs, etc.

Water management systems have to be planned as multi-purpose systems in order to rationalize water and land use, and account has to be taken of their economic justification and their impacts on the environment and nature. If due to uncoordinated priorities of various water and land users the development of the planned multi-purpose systems is not implemented according to the expected dynamics, preventive flood protection should, as a matter of public interest, be addressed by simpler solutions which would not in the future limit the development of multi-purpose systems. Water rights acts will continue to respect multi-purpose solutions envisaged under physical plans, and the water management sector will systematically encourage their development.

Small watercourses running through towns and settlements should be regulated in accordance with local needs and urban planning documents, taking into consideration the landscape and architectural demands, and the needs of municipal infrastructural systems. For the purpose of preventive protection against ice floods, regulation works at critical locations will continue to be carried out systematically.

Target 1. Achieve the 100-percent functionality of flood protection systems by the end of 2038

### **3.2.4. Non-structural measures (Preventive Actions, Capacity Building of Professionals, Raising Awareness and Preparedness of General Public)**

The efficiency of operative flood defence will be improved through the modernization of current systems for the monitoring and forecasting of weather phenomena (on-line monitoring stations, radars, satellite images, forecasting models, etc.), and current communications systems. Flood forecasting models will be developed, officially adopted and regularly updated, and on international rivers they will be developed and coordinated in the framework of competent international bodies. Systematic monitoring and forecasting of weather phenomena and timely provision of relevant information to the competent services for operative flood defence are the responsibility of hydrological and meteorological services.

A flood defence plan will be drawn up for an integrated water system. Operative flood defence on boundary watercourses is carried out together with competent services from the neighbouring countries.

The protection and rescue services will ensure proper functioning of regional and local public alert systems; organize the work of the civil protection; prepare strategic, tactical and operative disaster management plans, and, if needed, organize appropriate exercises; organize the evacuation of inhabitants in case of need; organize emergency medical aid to affected population; and organize post-flood terrain recovery. Other agents in flood protection are: science-and-research institutions, the media and interested NGOs with active and constructive participation in the processes of development of planning documents.

Target 1. Reduce flood damage risk

Target 2. Increase the efficiency of operative flood defence measures

Target 3. Increase the capacity building and raise the level of preparedness of organizations responsible for operative flood defence

Target 4. Build capacity of professionals and institutions responsible for flood management

Target 5. Introduce principles of EU flood directive

Target 6. Raise awareness and preparedness of the general public on sub-basin-wide and local scale

Target 7. Prevent and mitigate pollution of water caused by floods

### **3.3. Bosnia and Herzegovina**

All targets and measures mentioned in this flood protection Action plan comply with the entity Water Laws and bylaws. Water Laws are harmonised on the entity level, as well as with the EC Water Framework Directive. Entity laws are adopted in 2006.

According to the existing Water management plan for Una, Vrbas, Bosna and Drina River, Study on Regulation and Management of the Sava River<sup>5</sup>, as well as on the basis of existing conditions and problems related to the flood protection in Bosnia&Herzegovina area (Republika Srpska and FBA), the long-term flood protection strategy in Sava River basin implicates:

- For constructed flood protection systems:
  - Regular maintenance of the flood protection structures, according to the available project documentation, criteria, standards and norms.
  - Reconstruction and construction of the flood protection structures to decrease flood hazard of the highly valuable areas.
- Gradual and broad implementation of non-structural flood protection measures (such as upgrade of the flood forecasting and warning procedures; introduction of flood maps into spatial plans, etc.).
- International cooperation in flood management on rivers which cross or represent the state border (Sava, Una and Drina River).
- International cooperation in flood management on other rivers in Bosnia&Herzegovina where the flood protection works could cause transboundary impacts.

#### **3.3.1. Regulation of land use and spatial planning**

Target 1. Include the flood surfaces into the spatial plans.

Target 2. Implementation of water areas into the municipal cadastre plans of municipalities (containing flood hazard maps - both for potentially and actually flooded areas - and flood risk maps).

Target 3. Determine the limitations related to the flood areas use

#### **3.3.2. Reactivation of former or creation of new, retention and detention capacities**

In Bosnia&Herzegovina one of the most effective flood protection measures is the construction of multi-purpose reservoirs. Reservoir operation regime is determined through the water management acts, as well as the reservoir volume, reserved for the flood wave storage.

The existing volume for flood wave storage is insufficient, so it needs to be increased by construction of new reservoirs and retentions on larger rivers. On smaller rivers, barrages in the upper basin part have to be constructed.

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<sup>5</sup> Carlo Lotti & C., 1972



Target 1. Preservation and control of existing retention areas for flood protection

Activities for reaching the mentioned target implicit the following:

- Coordinated management of the existing retention areas in Central Posavina and existing hydropower reservoirs on Drina River and its tributaries, as well as on the other Sava River tributaries in Bosnia&Herzegovina. Therefore, a joint plan and coordinated management agreed by Croatia – Bosnia&Herzegovina – Serbia and Montenegro is needed.
- Large hydropower reservoirs at the Drina, Lim, Uvac and Piva River are used for flood attenuation, i.e. they represent the key objects for flood protection. Coordinated operation is needed, according to the common plan and coordination agreed by Serbia – Bosnia&Herzegovina – Montenegro.

Target 2. Forming the new retention areas

Forming new retention areas implicates the following:

- In case that within the solution for hydropower use on the Sava River tributaries the new embankment construction is planned, it is necessary to predict new retention areas for flood waves reception, or to construct the reservoirs with aim of prevention from worsening of the flood defence conditions in the downstream river section.
- Construction of new multipurpose reservoirs (hydropower, water supply and water use for agriculture). Reservoir construction is planned in Drina River upper flow (Buk Bijela with compensational reservoir Foča). On Vrbas, Bosna and Drina River, construction of a number of small and middle sized hydropower objects is planned, which can have impacts on flood defence in the downstream areas. Coordination at management plans level is needed, to be agreed at the level Croatia - Bosnia&Herzegovina - Serbia.
- Protection of densely populated areas and agricultural areas on the tributaries of I and II order to the Sava River, construction of reservoirs (single purpose and multipurpose) of appropriate capacity.

### **3.3.3. Structural flood defence measures**

Existing flood defence objects have to be continuously maintained with aim of reaching their full operational functionality, as well as reconstructed in order to reach their stability and designed constructive characteristics.

For more significant rivers (tributaries of I and II order), it is necessary to complete the flood defence objects construction or to form new flood defence lines for the areas with potentially greatest damages and areas exposed to the floods.

Target 1. Provide protection for the adopted design 100-year flood along the Sava River.

Forming new retention areas implicates the following:

- This is an adequate criterion for the protection of the Sava riparian lands, considering the size of the potentially endangered areas, number of inhabitants and the infrastructure value. This target, as the first activity, implicates remediation of existing flood defence systems (reconstruction of existing pumping stations, reconstruction of embankments and river banks supports, reconstruction of melioration and periphery channels), as well as reconstruction of existing objects (existing embankments level to the projected embankment top level and construction of new river bank supports for protection of agricultural land against the erosion).

Target 2. Provide protection for the adopted design 100-year flood for areas along the tributaries of I and II order

- Protection of cassettes with more than 20.000 inhabitants living in it, as well as the large and significant industrial and other economic facilities. It implicates reconstruction of the existing and construction of new objects for flood defence (Prijeđor and Derventa urban areas).

Target 3. Sediment management and torrent control: Provide adequate measures for sediment management and torrent control.

- Apply anti-erosion watershed management and torrent control measures with optimal combination of biological, biological–technical and technical measures. Apply controlled river sediment excavation to preserve channel conveying capacity and flow regime.

### **3.3.4. Non-structural measures (preventive actions, capacity building of professionals, raising awareness and preparedness of general public)**

The non-structural flood defence measures include institutional and preventive measures for lowering the flood consequences, as well as other measures related to decreasing the flood hazard. These measures provide all information to the general public and all subjects in flood defence system that can support increased flood defence efficiency.

The non-structural measures implicit:

- Preventive and operative tasks (setting up or improving the data base on natural events and protection system characteristics, modification of the existing plans for flood coping practices, adoption of reservoir operational rules, development/improvement of flood forecast and warning system);
- Regulative and institutional measures (zoning of floodplains, floodplain management policy, flood zones construction standards etc.);
- Managerial and technical education, providing necessary institutional capacities, as well as informing activities and public awareness building on flood hazards and possible damages.

The need to exchange the available data between neighbouring countries, with aim of improving the flood defence system and control of transboundary impacts, is accomplished through the international conventions and bilateral agreements of interested countries at the basin level or regional level.

The following targets are to be accomplished:

Target 1. Reduce flood risk

Target 2. Introduce principles of EU flood directive

Target 3. Build capacity of professionals and institutions responsible for flood management

Target 4. Strengthening the capacity of experts and institutions in charge for flood management

Target 5. Upgrade flood monitoring, data collection, forecast and warning

Target 6. Improve the public awareness on floods

Target 7. Improve the international cooperation in flood management

### 3.4. Serbia

Implementing criteria from the Water Management Master Plan of the Republic of Serbia, and taking into account the actual flood protection conditions and problems (especially the size of flood prone areas and possible damages) the long term flood protection strategy in the Sava River basin in Serbia will comprise:

- The existing layout of flood protection structures remains the same, while the following is planned:
  - Regular maintenance of the flood protection structures, according to criteria, standards and norms;
  - Reconstruction or/and construction of the flood protection structures to decrease flood hazard of the highly valuable areas (like Belgrade and Mačva region).
- Gradual and broad implementation of non-structural flood protection measures (as upgrade of the flood forecasting and warning procedures; introduction of flood maps into spatial plans, etc.).
- International cooperation in flood management on rivers which cross or represent the state border (Sava, Drina, Lim and Bosut River).

#### 3.4.1. Regulation of land use and spatial planning

Target 1. Spatial plans of municipalities contain flood hazard maps (both for potentially and actually flooded areas) and flood risk maps.

Target 2. Limitations related to land use in flood prone areas are defined.

#### 3.4.2. Reactivation of former, or creation of new, retention and detention capacities

Target 1. Existing – natural retention areas along the Sava and the Lower Drina are preserved. If within Hydropower project on Lower Drina new levees are planned, new retention capacities should be considered for flood attenuation.

Target 2. Protection of densely populated areas by new detention capacities (small single or multipurpose reservoirs). Planned at small tributaries of the Sava River in the Belgrade region.

Target 3. Large hydropower reservoirs at the Drina, Lim and Uvac are used for flood attenuation. Coordinated operation is needed, according to common plan and coordination with BA.

Target 4. Coordinated operation of hydropower reservoirs at Drina River and Middle Sava retentions. Common plan and coordination with Bosnia&Herzegovina and Croatia are needed.

#### 3.4.3. Structural flood defences

Target 1. Provide protection for the adopted design 100-year flood along the Sava River. This is an adequate criterion for the protection of the Sava riparian lands, considering the size of the potentially endangered areas, number of inhabitants and infrastructure value.

Target 2. Provide flood protection of first-order priority areas within the Sava River basin (protection of flood cells with more than 20,000 inhabitants, large and significant industrial and other facilities)

- Target 3. Provide flood protection of second-order priority areas within the Sava River basin (protection of areas with 5,000 to 20,000 inhabitants, medium industrial and other facilities, significant drainage and irrigation systems or water-supply sources).
- Target 4. Provide adequate measures for sediment management and torrent control. Apply anti-erosion watershed management and torrent control measures with optimal combination of biological measures (forestation, forest melioration, pasture melioration, etc.), bio-technical measures (contour trenches, terraces etc.), and technical measures (check dams and river-bed training). Apply controlled sand and gravel excavation to preserve channel conveying capacity and flow regime.
- Target 5. Provide permanent preparedness of the flood defence system.

#### **3.4.4. Non-structural measures (preventive actions, capacity building of professionals, raising awareness and preparedness of general public)**

The non-structural measures (encompassing institutional, preventive, corrective and other measures) should be given an appropriate role in flood control and mitigation. Main activities should be tied to:

- Preventive and operative tasks (setting up or improving the data base on natural events and protection system characteristics, modification of the existing plans for flood coping practices, adoption of reservoir operational rules, development/improvement of flood forecast and warning system);
- Regulative and institutional measures (zoning of floodplains, floodplain management policy, construction standards etc.);
- Managerial and technical education, as well as public awareness building.

All these tasks will be tied together within the Flood risk management plan for the Sava River basin.

- Target 1. Reduce flood risk
- Target 2. Introduce principles of EU flood directive
- Target 3. Build capacity of professionals and institutions responsible for flood management
- Target 4. Upgrade flood monitoring, forecast and warning
- Target 5. Introduce regulations for emergency situations response (natural disasters)
- Target 6. Prepare Flood risk management plan
- Target 7. Improve awareness of stakeholders on floods
- Target 8. Update/build scientific base for flood management
- Target 9. Improve international cooperation in flood management

#### 4. MEASURES TO ACHIEVE TARGETS

Targets	Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment	
<b>4.1. Regulation on land use and spatial planning</b>							
SI	<b>Target 1: Spatial plans must consider limitations and conditions</b> ( <i>Decree on conditions and limitations for constructions and activities on flood risk areas</i> )	flood indication map - information of existing data	Administrative	MOP		continuous	Preliminary maps prepared on local data
		flood hazard and hazard class map	Administrative	MOP		continuous	
		conditions and limitations for constructions and activities on flood hazard areas	Administrative	ARSO		continuous	
		detailed designation of boundary of waterside land	Administrative	MOP		continuous	
		conditions and limitations for defined waterside land	Administrative	MOP/ARSO		continuous	
HR	<b>Target 1: Solving problems related to the water estate</b>	Drafting and adoption of regulations (criteria for identification, zoning of the terrain and gradation of limitation restrictions in the use of the water estate)	Administrative	MRDFWM, HV, MEPPPC			
		Delineation of the water estate, entry into land registers and physical plans	Administrative	MRDFWM, HV, MEPPPC			
		Solving property-right relations to legalise flood protection structures (repurchase of real estate, getting location and construction permit)	Administrative	MRDFWM, HV, MEPPPC			

Targets		Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
		Systematic monitoring of the status of ownership on the water estate.	Administrative	MRDFWM, HV, MEPPPC			
	<b>Target 2 Provide information of areas at risk to give input to spatial planning</b>	Introduction of flood risk maps and flood damage maps for the entire country, and their presentation to the interested public	Administrative	MRDFWM, HV, MC		uncertain	
		Introduction of appropriate indicators and systematic monitoring of the efficiency of flood and erosion control measures	Administrative	MRDFWM, HV, MC		uncertain	
		Preparation and systematic maintenance of: the Inventory of water bodies, water estate and water structures, the Inventory of extreme hydrologic phenomena (floods, storms and droughts) and the Inventory of the status of erosion and anti-erosion measures taken	Administrative	MRDFWM, HV, DHMZ, HS		continuous	
<b>BA</b>		<b>Target 1: Inclusion of flood areas into the spatial plans</b>	Inclusion of determined flood areas into the spatial plans and other planning documentation	Administrative	EMPŠV, EAVP EMPUGE, EMULS		continuous
	Creation of the missing maps of flood hazards for rivers of I and II category		Administrative	EMPŠV, EAVP		continuous	According to the level of vulnerability of area defended against flood.
	<b>Target 2: Introducing the water surfaces to the municipal cadastre plans</b>	Creation of the Report for determination the limits of water surfaces in the municipal cadastre along tributaries of the I and II order	Administrative	EMPŠV, EAVP, MPUGE		2011	According to the level of vulnerability of area defended against flood.

Targets		Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
	<b>Target 3: Determination of limitation related to the flood surfaces use</b>	Application of limitations related to the flood areas and water surfaces along the tributaries of the I and II order	Administrative	EMPŠV, EAVP, EMPUGE, EMULS		continuous	According to the level of vulnerability of area defended against flood.
		Application of agro-technical measures, forests managing measures and land in accordance with the nature protection.	Administrative	EMPUGE, EMULS, EMPŠV, EAVP		continuous	
RS	<b>Target 1: Spatial plans of municipalities contain flood hazard maps and flood risk maps</b>	Defining water estate	Administrative	MAFWM-RDW, PWMCies		continuous	
		Introduction of flood maps into spatial plans of municipalities	Administrative	MESP			
	<b>Target 2: Limitations related to land use in flood prone areas are defined</b>	Preparation of instructions for limitations on land use	Administrative	MAFWM-RDW, MESP			
		Land use limitations applied	Administrative	LRSG			
<b>4.2. Reactivation of former, or creation of new, retention and detention capacities</b>							
SI	<b>Target 1: Restricting the aggravation of the high water regime due to man-made activities</b> ( <i>The compensation measures must be performed</i> )	Improvement of efficiency of existent or/and creation of new retention and detention capacities	Scientific	MOP/ARSO/IZVRS		in progress	Reducing flood risk on southwest of Ljubljana. Detention reservoirs are planed on areas which are flooded today.

Targets		Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
							<p>The similar principle (several detention reservoirs on already flooded areas) is planned on Savinja River basin reducing flood risk in Celje and some smaller settlements near the Savinja River and tributary Bolska River.</p> <p>The similar principle (detention reservoir) on Sora River basin is reducing flood risk in Železniki.</p>
HR	<b>Target 1: Preserving and improving natural retention capacities</b>	Existing large lowland retention storages in the Sava River basin are preserved	Administrative	MRDFWM, HV		continuous	Lonjsko polje, Mokro polje, Zelenik, Kupčina and Jantak (total volume of 1.590 hm <sup>3</sup> )
		Existing multipurpose reservoirs are used for flood attenuation	Administrative	MRDFWM, HV		continuous	Coordinated operation of existing multipurpose reservoirs (total volume of 73 hm <sup>3</sup> )
		Existing mountain retention storages are used for flood attenuation	Administrative	MRDFWM, HV		continuous	Coordinated operation of existing mountain retention storages (total volume of 2,5 hm <sup>3</sup> )
		Design and construction of new mountain retention storages	Technical	MRDFWM, HV		started	



Targets		Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
		<p>Introduction of restoration measures of preventive flood protection:</p> <ul style="list-style-type: none"> <li>- reduction of flood wave peak flows by reactivating former floodplains and restoring watercourses;</li> <li>- Implementation of the Best Practices of Flood Prevention Protection and Mitigation in land use management</li> </ul>	Administrative	MRDFWM, HV, MC, MEPPPC, LRS, OTHER		continuous	
BA	<b>Target 1: Preservation and control of existing retention areas for flood defence</b>	Through the Water acts, defining of the necessary storage volume and operation regime of the existing retentions and reservoirs for flood defence	Administrative	EMPŠV <sup>6</sup> , AVP		continuous	Coordinated management of existing retentions in Central Posavina and hydropower reservoirs at Drina, Lim and Piva River, with the aim of decreasing the peak of the flood wave on the Drina River. (joint plan and coordination at the level of HR-BA-RS-ME).
		Reconstruction measures for flood defence existing objects.	Administrative – technical	EMPŠV, AVP		continuous	Planned only the maintenance, reconstruction and levelling the embankments up to the projected height levels, as well as reconstruction of the lateral and drainage channels.

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<sup>6</sup> Letter E in front of the institution means Entity institution

Targets	Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
<b>Target 2: Creation of new retention areas (large and small multipurpose reservoirs)</b>	Consideration of possibilities for construction of new multipurpose reservoirs and retentions	Technical	EMPŠV, AVP, EMPEP		2015	Planned construction of reservoirs HPP Buk Bijela, compensational HPP Foča and HPP Banja Luka niska. It is necessary to agree and coordinate on the level HR-BA-RS.
	Design and construction of new multipurpose reservoirs, as well as the barrages and retentions on the Sava River tributaries in BA	Technical	EMPŠV, AVP, EMPEP		continuous	Planned construction of the number of Small HPPs on the Sava River tributaries in BA. It is necessary to provide information to the downstream basin countries.
	Creation of guidelines for new reservoirs and retention work regime	Administrative – technical	EMPŠV, AVP, EMPEP		2015	Coordination at the Sava Commission level.
	Design and construction of a new flood defence system	Technical	EMPŠV, AVP		continuous	Planned on the Sava River tributaries and tributaries of the II order in Derventa area (Ukrina), Prijedor area (Sana and Gomijenica River), Bosna River (Doboj – Šamac area).

Targets		Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
RS	<b>Target 1: Existing – natural retention areas along the Sava and the Lower Drina River are preserved</b>		Administrative/Technical	PWMCies		continuous	<p>New levees along the Sava and Drina River will not be erected.</p> <p>Old “summer” dike Provo-Orlača at Sava River, which protects agricultural land, will not be reconstructed.</p> <p>If within Hydropower project on Lower Drina River new levees are planned, new retention capacities should be considered for flood attenuation.</p>
	<b>Target 2: Protection of densely populated areas by new detention capacities (or small single or multipurpose reservoirs)</b>	Design and building	Technical	PWMCies		started	Planned at small tributaries in the Belgrade region (Topčiderska i Barička reka)
		Preparation of Operation manual	Technical	PWMCies			Only in case of reservoirs, not for retentions.
	<b>Target 3: Large hydropower reservoirs at the Drina, Lim and Uvac River are used for flood attenuation</b>	Common study of possibilities	Scientific	MAFWM-RDW, PWCies, EPS + bilateral commission + ISRBC			Coordinated operation of the existing hydropower reservoirs at Drina, Lim and Uvac River with aim to attenuate peak of the Drina flood wave (common plan and coordination with BA)
		Preparation/update of Operation manual	Administrative/technical	MAFWM-RDW, PWCies, EPS + bilateral commission + ISRBC			

Targets		Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
	<b>Target 4: Coordinated operation of hydropower reservoir at Drina and Middle Sava retentions</b>	Common study of possibilities	Scientific	MAFWM-RDW, PWCies, EPS + bilateral commission + ISRBC			
		Preparation of Operation manual	Administrative/technical	MAFWM-RDW, PWCies, EPS + bilateral commission + ISRBC			Coordinated operation of hydropower reservoir at the Drina and the Central Posavina retentions (common plan and coordination with BA and Croatia are needed)
<b>4.3. Structural flood defences</b>							
SI	<b>Target 1: Provide flood protection for existing settlements on lower section of the Sava River due to construction of hydropower plants</b>	improvement of existing dikes and creation of new ones	Scientific /Technical	MOP/ARSO		depending on time-table of building of hydropower stations	
HR	<b>Target 1: Achieving the 100% functionality of the flood protection systems</b>	Gradual implementation of repair and reconstruction works on about 5000 km of protective systems	Technical	MRDFWM, HV, HEP, OTHER		2038	It is anticipated that 87-percent functionality of the flood protection systems will be achieved by the end of 2023 and 100-percent functionality by the

Targets		Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
		Design and construction of 270 km of protective systems	Technical	MRDFWM, HV, HEP, OTHER		2038	end of 2038.  From the point of view of health, safety and environment, the priorities of first order in preventive flood protection are the areas of large and larger towns with more than 30,000 inhabitants, potentially at risk from major rivers – the Sava and Kupa River. The priorities of second order are other towns and settlements along the Sava, Kupa and Una River.
		Regular maintenance of watercourses, water estate, and water structures; systematic technical monitoring of key water structures	Technical	MRDFWM, HV		continuous	
		Finishing the construction of the Lonjsko polje retention  - reconstruction and partial construction of the existing Southern levee of the Lonjsko polje retention  - construction of Palanjek weir	Technical	MRDFWM, HV		2012	Priority works related to the further development of the Central Posavina system – one of the main objectives of Inland Waters Project co-financed by World Bank funds  The Project has been implemented in the period 2008-2012.
		Support to solving flood protection problems within multi-purpose systems for the regulation and use of water and land	Technical	MRDFWM, HV, HEP, OTHER		continuous	

Targets		Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment	
BA	<b>Target 1: Providing the flood defence for adopted floods of the 100-years period along the Sava River area</b>	Regular ongoing maintenance of existing objects for flood defence	Administrative-technical	EMPŠV, EAVP, EVP		continuous	This measure is of the highest priority range.	
		Reconstruction and remediation of the flood defence system objects along the Sava River area in FBA.						
		Reconstruction and remediation of the flood defence system objects along the Sava River area in Republika Srpska.						
		Reconstruction of 14.0 km right Sava River embankment in Kozarska Dubica municipality area.	Technical	MPŠV- AVORSS, VP	8.000.000	2015	1. priority task. Embankment levelling (app. 1.0 m) up to the designed height level - 100-year rang flood.	
		Reconstruction of 5.0 km right Sava River embankment in Bijeljina municipality area.	Technical	MPŠV- AVORSS, VP		2015	2. priority task. Embankment levelling (approx.1.0 m) up to the designed height level - 100- year range flood.	
		Reconstruction and repair of 16 existing pumping stations for flood defence. 10 PS in Kozarska Dubica and Gradiška, 2 PS in Brod and 4 PS in Bijeljina.	Technical	MPŠV- AVORSS, VP	3.500.000	2015	3. priority task. Activities of reconstruction and repair of the object PS include construction, machine and electro-phase.	

Targets	Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
	Landslide sanation at Sava River embankment (right bank) in Lijevče polje area. Total 1.7 km of landslide.	Technical	MPŠV- AVORSS, VP	800.000	2015	4. priority task.  Activities of landslide sanation include embankment slope stabilization at the sections of landslides appearance.
	Periphery channels repair of total length 193 km.	Technical	MPŠV- AVORSS, VP	3.500.000	2015	5. priority task  Activities implicit cutting the vegetation and cleaning the sludge from channels with partial repair of river banks and embankments along the periphery channels.
	Reconstruction and repair of flood defence system objects along the Sava River area in Brčko District.					
	Reconstruction of Sava embankment in Brčko District area, in total length of 8.25 km.	Technical	VBD	3.000.00	2015	6. priority task  Activities implicit landslide sanation, existing embankment levelling and construction of new embankment section.
	Regulation of Brka and Zovičica River, in the length of 2.6 km (regulation sequence) – Brčko District.	Technical	VBD	5.000.000	2015	7. priority task  Activities implicit embankment construction and river bed regulation

Targets	Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
	Regulation of Teka River (Tinja River regulation sequence) – Brčko District.	Technical	VBD	4.200.000	2015	8. priority task  Activities implicit embankment construction and river bed regulations.
<b>Target 2: Providing the flood defence for adopted floods of 100-years period for the areas along the tributaries to the Sava River of the I and II order</b>	Regular ongoing maintenance of regulated waterway sections	Administrative-technical	EMPŠV, EAVP, EVP		continuous	This measure is the highest priority measure.
	Designing and construction of existing objects for flood defence in the area along the rivers of I and II category, according to the vulnerability rang and significance of the protected area.					
	Prijedor urban area, Sana and Gomijenica River regulation (reconstruction of existing objects and construction of new embankments)	Technical	EMPŠV, EAVP, EVP		2020	9. priority task Activities implicit the reconstruction of existing and construction of new embankments and river bed regulation.
	Derventa urban area , Ukrina River regulation (regulation sequence, construction of new embankments)	Technical	EMPŠV, EAVP, EVP		2020	10. priority task Activities implicit the reconstruction of existing and construction of new embankments and river bed regulation.
<b>Target 3: Sediment management and torrent regulation</b>	Application of anti-erosion measures in the basin and measures for torrents control.	Administrative - technical	EMPŠV- EAVP, EVP, EJPŠ, EMPER, EMULS, EOST		continuous	Optimal measures combination (biologic, biologic –technical and technical).
	Maintenance of objects for erosion and torrents defence	Technical	EMPŠV, EAVP, EVP		continuous	
	Application of anti-erosion measures in the basin – Republika Srpska					



Targets		Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
		Eroded river banks reconstruction on the Sava River tributaries:  Vrbas River, 9 locations, 5.1 km  Bosna River, 4 locations, 1.5 km  Drina River, 4 locations, 2.1 km	Technical	MPŠV- AVORSS	3.000.000	2015	11. priority task  Reconstruction includes the construction of river bank supports with the aim of agricultural land erosion defence, as well as the protection of the traffic corridors.
RS	<b>Target 1: Provide protection for the adopted design 100-year flood along the Sava River</b>	Reconstruction of key walls on the Sava left bank in New Belgrade (6.2 km)	Technical	PWCies + city of Belgrade			First and urgent task
		Reconstruction of 13 km of levees on the left bank of Sava (Lower Srem)	Technical	PWC Vode Vojvodine			
		Reconstruction of 2.1 km long levee near Hrtkovci	Technical	PWMC VV			
		Reconstruction or sluice and pumping station Bosut	Technical	PWC Vode Vojvodine + bilateral commission with Croatia			Adopt bilateral agreement related to sharing costs for evacuation of high waters through RS territory
		Reconstruction of key walls on the Sava right bank in Belgrade (4 km)	Technical	PWCies + City of Belgrade			First and urgent task
		Reconstruction of right bank levees between Belgrade and Kolubara mouth (approx. 9 km)	Technical	PWCies + City of Belgrade			
		Reconstruction of levees in the Macva region (31.3 km ) with sluices and pumping stations	Technical	PWC Srbijavode		started	

Targets	Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
<b>Target 2: Provide flood protection of first-order priority areas within the Sava River basin</b>	Carry out reconstruction or construction of flood protection structures	Technical	PWC Srbijavode		continuous	Protection of flood cells with more than 20,000 inhabitants, large and significant industrial and other facilities. Required safety level for a certain area depends on technical, economic, ecologic, social, political and other criteria, conditions and limitations and may be changed in time.
<b>Target 3: Provide flood protection of second-order priority areas within the Sava River basin</b>	Carry out reconstruction or construction of flood protection structures	Technical	PWC Srbijavode		continuous	Protection of areas with 5,000 to 20,000 inhabitants, medium industrial and other facilities, significant drainage and irrigation systems or water-supply sources. Required safety level for a certain area depends on technical, economic, ecologic, social, political and other criteria, conditions and limitations and may be changed in time.
<b>Target 4: Provide adequate measures for sediment management and torrent control</b>	Apply anti-erosion watershed management and torrent control measures	Technical	PWC Srbijavode, PCSS		continuous	Optimal combination of biological measures (forestation, forest melioration, pasture melioration, etc.), bio-technical measures (contour trenches, terraces etc.), and technical measures (check dams and river-bed training).
<b>Target 5: Provide permanent preparedness of the flood</b>	Maintenance of flood protection structures	Technical	MAFWM-RDW, PWMCies, LRSG, OTHER		continuous	According to specific standards and norms.

Targets		Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
	<b>defence system</b>	Maintenance of erosion and torrent control structures	Technical	MAFWM-RDW, PWMCies, PCSS, LRSG, OTHER		continuous	According to specific standards and norms.
		Maintenance of dams, retention basins and reservoirs used for flood protection	Technical	MAFWM-RDW, PWMCies, EPS		continuous	According to specific standards and norms.
		Purchase and repair of machinery, tools, materials, equipment and communications	Technical	MAFWM-RDW, PWMCies,		continuous	According to specific standards and norms.
<b>4.4. Non-structural measures (preventive actions, capacity building of professionals, raising awareness and preparedness of general public)</b>							
<b>SI</b>	<b>Target 1: Preventive actions</b>	Flood indication map - information on existing data	Administrative/Scientific	MOP		continuous	
		Improvements in flood forecasting and warning (forecasting hydrological events and launching flood warnings)	Administrative/Technical/Scientific	ARSO/ Notification Centre of the Republic of Slovenia		continuous	
	<b>Target 2: Capacity building of professionals</b>	Workshops: enforcement of prevention principle for reducing the risk instead of assuring of certain degree of safety	Administrative/Scientific	MOP/ARSO/IZVRS		2015	probably will continue after 2015
		Workshops: on harmonisations of elaboration of hazard and risk maps	Scientific	MOP/ARSO/IZVRS		2015	probably will continue after 2015
		Workshops: for administrative professionals which are involved in spatial planning	Scientific	MOP/ARSO/IZVRS		2015	probably will continue after 2015
	<b>Target 3: Raising awareness and preparedness of general</b>	flood indication map - information of existing data	Administrative/Scientific	MOP		continuous	

Targets		Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
	<b>public</b>	workshops on implementations of Flood directive	Administrative/Scientific	MOP/ARSO/IZVRS		continuous	
		flood forecasting and warning (workshops, public campaigns, demonstrations)	Administrative/Scientific	MOP/ARSO/IZVRS/ MO		continuous	
		adoption and execution of regulations for adaptation of construction in flood risk areas	Administrative/Scientific	MOP/ARSO/IZVRS/ MO		2010, continuous	
	<b>Target 4: Spatial plans must include restricting measures of enlargement on flood hazard areas in order to prevent and mitigate the water pollution due to floods</b>	flood indication map - information of existing data	Administrative	MOP		continuous	
		flood hazard and hazard class map	Administrative	MOP		continuous	
		conditions and limitations for constructions and activities on flood hazard areas	Administrative	ARSO		continuous	
<b>HR</b>	<b>Target 1: Reduce flood damage risk</b>	Implementation of operative flood defence measures	Technical / Organizational	MRDFWM, HV		continuous	
		Managing and coordinating the operation of multipurpose reservoirs and water distribution structures during high water periods	Technical / Organizational	MRDFWM, HV, HEP, OTHER		continuous	
	<b>Target 2: Increase the efficiency of operative flood defence measures</b>	Improving the system of automated weather stations and gauging stations, and making the measured data available to relevant services in real time	Technical / Organizational	MRDFWM, HV, DHMZ		continuous	

Targets	Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
	Improving the system of hydrological and weather forecasting, and making the created forecasts available to relevant services; establishment of local forecasting centers and application of the latest technologies in forecasting - monitoring and water information system	Technical / Organizational	MRDFWM, HV, DHMZ		continuous	
	Improvement of alarm systems and systems for issuing timely warning to population at risk; organizing improved operations of the police and fire fighting forces during floods; organizing evacuation of population, if needed; organizing life on damaged areas by providing humanitarian aid, organizing medical services, and emergency recovery of essential infrastructure	Technical / Organizational	NPRD		continuous	
	Improvement and formalizing of international basin wide on line flood related meteorological and hydrological data exchange	Administrative	HV, DHMZ		continuous	
	Improvement and formalizing of international basin wide on line operative flood defence information exchange	Administrative	HV, NPRD		continuous	
	<b>Target 3: Increase the capacity building and raise the level of preparedness</b>	Preparation, adoption, and regular updating of the National Flood Defence Plan	Administrative	MRDFWM, HV		continuous

Targets	Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
<b>Target 4: Build capacity of professionals and institutions</b>	Support of scientific and educational projects related to all aspects of floods.	Administrative	HV, MSES, MRDFWM		continuous	
	Professional education of scientific personnel to perform the tasks of integrated water resources management. It is necessary to create new interdisciplinary plans and programs of education.	Scientific	HV, MSES, MRDFWM		continuous	
<b>Target 5: Introduce principles of EU Floods directive</b>	Continue action in the framework of international multilateral and bilateral agreements.	Administrative	MRDFWM, HV MFAEI, MEPPPC, MC		continuous	
	Bring into force the laws, regulations and administrative provisions complied with Flood Directive	Legal/ Administrative	MRDFWM, HV		26 November, 2009	
	Decision on units of management	Legal/ Administrative	MRDFWM, HV		26 May, 2010	
	The Preliminary flood risk assessment	Scientific/ Technical	MRDFWM, HV		22 December, 2011	
	Preparation of flood hazard and flood risk maps	Scientific/ Technical	MRDFWM, HV		22 December, 2013	

Targets		Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
		Preparation of Flood risk management plan	Scientific/ Technical	MRDFWM, HV		22 December 2015	
	<b>Target 6: Raise awareness and preparedness of the general public</b>	Presentation of flood risk and flood damage maps to the interested public	Administrative	MRDFWM, HV, MC		continuous	
		Introducing the principle of covering uncovered flood damage risks through insurance policies	Administrative	MRDFWM, HV, MF		continuous	
	<b>Target 7: Prevent and mitigate pollution of water caused by floods</b>	Recovery of the current sources of pollution on the areas potentially at risk	Administrative	MRDFWM, HV, MEPPPC, MHSW, LRSG		continuous	
<b>BA</b>	<b>Target 1: Flood risk reducing</b>	Implementation of operative flood defence measures defined by flood defence operational plans	Technical /Organisational	EMPŠV- EAVP, EVP, EUCZ EMPER, EMULS, EOST		continuous	
	<b>Target 2: Introducing the principles of EU flood directive</b>	Creation of agreed methodology for the production of the flood hazard maps and the vulnerability maps	Scientific/ Technical	EMPŠV, EAVP		2010	The following will be used:  Common approach of the Sava countries (ISRBC PEG-FP), agreed with ICPDR approach
		Creation of preliminary estimation of flood hazards	Administrative	MVTEO, EMPŠV, EAVP		2014	
		Creation of vulnerability maps and flood hazards maps	Administrative	EMPŠV, EAVP		2015	

Targets	Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
	Creation of the flood risk management plans	Administrative	EMPŠV, EAVP		2016	
<b>Target 3: Build the capacity of professionals and institutions responsible for flood management</b>	Preparation, adoption and updating the flood defence plans	Administrative	EMPŠV- EAVP		2016	Entity level. Necessary compliance at entity level and Sava Commission level.
	Continuous data exchange between institutions in charge for flood defence.	Administrative	EMPŠV- EAVP, EHMZ, EUCZ, MULS		continuous	At all levels
<b>Target 4: Strengthening the capacity of professionals and institutions responsible for flood management</b>	Support to the scientific and educational projects related to the flood aspects	Administrative	EMPŠV, EAVP, EMOT, EUCZ		continuous	Measured data available to the institutions in charge in real time at entity and BA state level.
	Professional experts training for application of water resources integral management principle	Administrative	EMPŠV, EAVP, EHMZ, EUCZ		continuous	Introduction of modern technologies at state and entity level.
<b>Target 5: Improvement of the monitoring system, data collecting, forecasting and warning.</b>	Improvement of automatic forecasting stations and water-measuring stations with the possibility of adequate data displaying in ISV	Technical / organisational	EMPŠV, EAVP, EHMZ, EUCZ		continuous	
	Improvement of meteorological and hydrologic forecasting systems, with data displaying in ISV	Technical / organisational	EMPŠV, EAVP, EHMZ, EUCZ		continuous	
	Improvement of the system for beforehand informing, warning and alerting the people under the flood hazard.	Technical / organisational	EMPŠV, EAVP, EHMZ, EUCZ		continuous	Entity associations of civil protection are in charge for the organisation of the evacuation of population, as well as for providing help to people under the flood hazard.



Targets		Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
		International exchange of meteorological and hydrological data, as well as data on flood defence operational measures.	Administrative	MVTEO, EMPŠV, EAVP, EHMZ, EUCZ		continuous	Coordination at the Sava Commission level
	<b>Target 6: Improvement of public awareness on floods</b>	Presentation and providing of public access to the flood hazard and the flood vulnerability and the flood hazards maps.	Administrative	EMPŠV, EAVP		2012	Common approach of the Sava countries will be applied (ISRBC PEG- FP), in compliance with the ICPDR approach
		Implementation of flood insurance system	Administrative	EMPŠV, EAVP		2016	
		Public awareness of the flood life strategy	Administrative	EMPŠV, EAVP		continuous	
		Creation of fliers, movies, radio and TV shows	Administrative	EMPŠV, EAVP		continuous	
		<b>Target 7: Improve international cooperation in flood management</b>	Participation in ICPDR work	Administrative	MVTEO, EMPŠV, EAVP		continuous
	Participation in Sava Commission work		Administrative	MVTEO, EMPŠV, EAVP		continuous	
	Signing the bilateral agreement with Serbia and Montenegro		Administrative	MVTEO		continuous	
<b>RS</b>	<b>Target 1: Reduce flood risk</b>	Implementation of operative flood defence measures	Technical/ Organizational	PWMCies, LRS G		continuous	
	<b>Target 2: Introduce principles of EU flood directive</b>	Preparation and adoption of new Water Law	Legal/ Administrative	Republic of Serbia, MAFWM-RDW		2010	

Targets	Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
	Preparation of bylaws according to new Water Law	Legal/ Administrative	MAFWM-RDW		2011	
<b>Target 3: Build capacity of professionals and institutions responsible for flood management</b>	Regular upgrade of General and Annual Flood Defence Plans for the Republic of Serbia	Administrative	MAFWM-RDW		continuous	State level – increased efficiency of operative flood defence.
	Preparation and regular upgrade of General and Annual Flood Defence Plans for municipalities	Administrative	LRSB		continuous	Municipality level – increased efficiency of operative flood defence.
	Characterisation of current situation	Technical	MAFWM-RDW, PWCies		2009	Finished partially.
	Update/preparation of technical documentation for all existing flood protection structures (incl. data on water estate)	Technical	PWCies			Finished partially.
	Update/preparation of flood defence manual	Technical	MAFWM-RDW		2010	
	Preparation of bylaw for establishment and management of cadastre of water structures	Administrative	MAFWM-RDW		2010	
	Preparation of cadastre of flood protection structures	Technical	PWCies, LRSB		continuous	
	<b>Target 4: Upgrade flood monitoring, forecast and warning</b>	Improvement of the system of automated weather and gauging stations	Technical/ Organizational	RHMSS, MAFWM-RDW		continuous

Targets	Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
	Improvement of the system of hydrological and weather forecasting	Technical/ Organizational	RHMSS, MAFWM-RDW		continuous	Introduction of the latest technologies in forecasting. Forecasts available to relevant services through WMISS and by other IT.
	Improvement of alarm systems and systems for issuing timely warning to population at risk	Technical/ Organizational	RHMSS, MAFWM-RDW		continuous	
<b>Target 5: Introduce regulations for emergency situations response (natural disasters)</b>	Preparation of strategic, tactical and operative disaster management plans for catastrophic flood	Technical/ Organizational	MAFWM-RDW, PWCies, MI, LRSG			- Criteria for declaration of an emergency; - Information routes - Methods of public warning - Evacuation routes - Preparedness of public services
	Training exercises	Public participation	PWCies, LRSG, MI		continuous	- Organizing operations of the police and fire fighting forces as during floods; - Organizing evacuation of population; - Organizing life (medical services, and emergency recovery).
<b>Target 6: Prepare Flood risk management plan</b>	Preliminary flood risk assessment	Scientific	MAFWM-RDW		2011	Activities started. Required harmonization with neighbouring countries.

Targets		Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
		Preparation of methodology for flood risk mapping	Scientific/ Technical	MAFWM-RDW		2011	<p>Standard hydrological and hydraulic models should be revised or new should be developed for computation of reference high water levels. Also, methodology for digital mapping should be developed according to standard specifications. The following results/conclusions will be used:</p> <ul style="list-style-type: none"> <li>- Common position on flood risk mapping (ICPDR);</li> <li>- Flood risk project;</li> <li>- Tamnava project (Swedish Rescue Service and MAFWM-RDW).</li> </ul> <p>Common approach of Sava countries (ISRBC PEG FP)</p>
		Adoption of bylaw on methodology for flood risk mapping	Administrative	MAFWM-RDW		2011	
		Preparation of flood hazard maps	Scientific/ Technical	MAFWM-RDW, PWMCies		2013	Due to the extent of this activity and required high investments, project is supported by ISRBC PEG FP – Initial common hydraulic model for the Sava RB in cooperation with USACE.

Targets		Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment	
		Preparation of flood risk maps	Scientific/ Technical	MAFWM-RDW, PWMCies		2013	Supported by ISRBC PEG FP – Initial common hydraulic model for the Sava RB in cooperation with USACE.	
		Preparation of draft Flood risk management plan	Technical/ Organizational	MAFWM-RDW, PWMCies		2014	Sava countries will prepare an integrated plan or a plan coordinated on the level of the Sava River basin.  Support: Tamnava project (Swedish Rescue Service and MAFWM- RDW)	
		Public information and consultation on draft Flood risk management plan for the Sava River basin in Serbia	Public participation	MAFWM-RDW, PWMCies		2014-2015	Flood risk management plan and Flood risk maps should be discussed in public. The results, benefits and consequences of preparation of the flood risk maps as a legal act should be presented to a broad public.	
		Bring into force Flood risk management plan for the Sava River basin in Serbia	Administrative	MAFWM-RDW		2015		
		<b>Target 7: Improve awareness of stakeholders on floods</b>	Introduction of flood insurance	Administrative				
			Introduction of water management issues into schools	Public participation			continuous	From elementary school to university.
			Preparation of flood leaflet, film, TV broadcasts etc.	Public participation				

Targets	Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment	
<b>Target 8: Update/build scientific base for flood and ice management</b>	Preparation of studies and design	Scientific	All		continuous		
	<b>Target 9: Improve international cooperation in flood management</b>	Bring into force bilateral agreement with Croatia, Bosnia&Herzegovina and Montenegro and establish bilateral commission	Legal	Republic of Serbia		2010	
		The Sava River basin wide on-line flood related meteorological and hydrological data exchange	Administrative	Republic of Serbia + RHMSS bilateral commissions		2010	Improvement and formal agreement.
		The Sava River basin wide online operative flood defence information exchange	Administrative	Republic of Serbia + bilateral commissions		2010	Improvement and formal agreement.
		workshops on implementations of Flood directive	Administrative/Scientific	MOP/ARSO/IZVRS		continuous	
		flood hazard and hazard class map	Administrative	MOP		continuous	
		conditions and limitations for constructions and activities on flood hazard areas	Administrative	ARSO		continuous	

## ANNEX 1

### List of competent authorities responsible for preparation or implementation of the Sava Action Plans

Country	Name of institution	Abbreviation	Address
SI	Republic of Slovenia, Ministry of the Environment and Spatial Planning, Directorate for Water	MOP	Dunajska 48 1000 Ljubljana
	Institute for Water of the Republic of Slovenia	IZVRS (IWRS)	Hajdrihova 28c 1000 Ljubljana
	Environmental Agency of the Republic of Slovenia	ARSO (EARS)	Vojkova 1b 1000 Ljubljana
	Ministry of Defence, Administration of the Republic of Slovenia for Civil Protection and Disaster Relief	MO	Vojkova cesta 61 1000 Ljubljana
HR	Ministry of Regional Development, Forestry and Water Management	MRDFWM	Babonićeva 121 10000 Zagreb
	Hrvatske vode	HV	Ulica grada Vukovara 220 10000 Zagreb
	Meteorological and Hydrological Service	DHMZ	Grič 3 10000 Zagreb
	Hrvatska elektroprivreda (Croatian Power Company)	HEP	Ulica grada Vukovara 37 10000 Zagreb
	Hrvatske šume	HS	Ljudevita Farkaša Vukotinovića 2 10000 Zagreb
	Ministry of Culture	MC	Runjaninova 2, 10000 Zagreb
	Ministry of Environmental Protection, Physical Planning and Construction	MEPPPC	Ulica Republike Austrije 20 10000 Zagreb
	Ministry of Finance	MF	Katančićeva 5

Country	Name of institution	Abbreviation	Address
			10000 Zagreb
	Ministry of Health and Social Welfare	MHSW	Ksaver 200a 10000 Zagreb
	Ministry of Science, Education and Sport,	MSES	Donje Svetice 38 10000 Zagreb
	National Protection and Rescue Directorate, Ministry of the Interior	NPRD	Ulica grada Vukovara 33 10000 Zagreb
	Ministry of Foreign Affairs and European Integration	MFAEI	Trg N. Š. Zrinskog 7 -8 10000 Zagreb
<b>BA</b>	<b>STATE LEVEL – BOSNIA AND HERZEGOVINA</b>		
	Ministry of Foreign Trade and Economical Relations	MVTEO	Trg BiH 1 71000 Sarajevo
	<b>ENTITY LEVEL – REPUBLIC OF SRPSKA</b>		
	Ministry of Agriculture, Forestry and Water Management, Banja Luka	MPŠV	Trg Republike Srpske 1 78000, Banja Luka
	Water Agency for Sava River Basin, Bijeljina	AVORSS	Miloša Obilića 51 76300, Bijeljina
	Ministry of Spatial Planning, Civil Engineering and Ecology, Banja Luka	MPUGE	Vladike Platona bb 78000, Banja Luka
	Water Management Company "Semberija", Bijeljina	VPS	Račanska 29 76300 Bijeljina
	Water Management Company "Sava" a.d., Gradiška	VPSG	Gavrila Principa 2 78400, Gradiška
	Water Management Company "Ušće Bosne" a.d., Šamac	VPUB	Kralja Aleksandra I Karađorđevića 69, 76230, Šamac
	Water Management Company "Sava", Brod	VPSB	Živojina Mišića 1 74450, Brod
	Water Management Company "Srednja Posavina", Lončari	VPSP	Lončari bb



Country	Name of institution	Abbreviation	Address
			76278, Lončari
	Republic Hydro-Meteorological Institute, Banja Luka	RHMZ	Put Banjalučkog odreda bb 78000, Banja Luka
	Ministry of Economy, Energetics and Mining, Banja Luka	MPER	Trg Republike Srpske 1 78000, Banja Luka
	Public Company "Forests of Republic of Srpska", Sokolac	JPŠŠRS	Romanijska 1 71350, Sokolac
	Republic Management for Civil Protection, Istočno Sarajevo	RUCZ	Vuka Karadžića 17 71123 Istočno Sarajevo
	Ministry of Internal Affairs, Banja Luka	MUP	Bulevar Desanke Maksimović 4 78000, Banja Luka
	Ministry of Government and Self-government, Banja Luka	MULS	Trg Republike Srpske 1 78000, Banja Luka
	Other users	OST	
	ENTITY LEVEL – FEDERATION OF BOSNIA AND HERZEGOVINA		
	Federal Ministry of Environment and Tourism	FMOT	Alipašina 41, Sarajevo
	Federal Ministry of Spatial Planning	FMPU	Maršala Tita 9a, Sarajevo
	Federal Ministry of Agriculture, Forestry and Water Management	FMPVŠ	Tltova 15, Sarajevo
	Water Agency for Sava River Basin	AVP	Grbavička 41, Sarajevo
	Federal Hydro-Meteorological Institute	FHMZ	Bardakčije 12, Sarajevo
	Federal Administration for Civil Protection	FUCZ	Dženeta Čikma 14, Sarajevo
	Municipalities	OPC	
	BRČKO DISTRICT		
	Brčko District Government	VBD	Trg mira 1 76160, Brčko
<b>RS</b>	Ministry of Agriculture, Forestry and Water Management – Republic Directorate for Water	MAFWM-RDW	Bulevar umetnosti 2a 11070 Novi Beograd

<b>Country</b>	<b>Name of institution</b>	<b>Abbreviation</b>	<b>Address</b>
	Ministry of Environment and Spatial Planning	MESP	Nemanjina 11 11000 Beograd
	Public Water Management Company “Vode Vojvodine”	PWMC VV	Bulevar Mihajla Pupina 25 21000 Novi Sad
	Public Water Management Company “Srbijavode”	PWMC SV	Bulevar umetnosti 2a 11070 Novi Beograd
	Public Water Management Company “Beogradvode”	PWMC BV	Svetozara Ćorovica 15 11000 Beograd
	Republic Hydrometeorological Service of Serbia	RHMSS	Kneza Višeslava bb 11000 Beograd
	Electric Power Industry of Serbia – the Iron Gate Company	EPS	Pop Stojanova 2a 11000 Beograd
	Public Company “Vojvodinašume”	PCVŠ	Preradovićeva 2 21131 Petrovaradin
	Public Company “Srbijašume”	PCŠŠ	Bulevar Mihajla Pupina 113 11070 Novi Beograd
	Ministry of the Interior	MI	Bulevar Mihajla Pupina 2 11070 Novi Beograd
	Local and regional self-government units	LRSG	
	Other water and land users	OTHER	