INTERNATIONAL SAVA RIVER BASIN COMMISSION

FLOOD RISK MANAGEMENT PLAN IN THE SAVA RIVER BASIN

Supported by

THE WORLD BANK
IBRD · IDA | WORLD BANK GROUP

Western Balkans Investment Framework WBIF

An initiative funded by the European Union

INTERNATIONAL SAVA RIVER BASIN COMMISSION

Flood Risk Management Plan in the Sava River Basin

Western Balkans Investment Framework WBIF
An initiative funded by the European Union

THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP

This document has been produced with the financial assistance of the European Western Balkans Joint Fund under the Western Balkans Investment Framework. The views expressed herein are those of the author and can therefore in no way be taken to reflect the official opinion of the contributors to the European Western Balkans Joint Fund or the EBRD and the EIB, as co-managers of the European Western Balkans Joint Fund.

Flood Risk Management Plan in the Sava River Basin

The Parties to the Framework Agreement on the Sava River Basin (Bosnia and Herzegovina, Republic of Croatia, Republic of Serbia and Republic of Slovenia) approved this Plan at the Eight Meeting of the Parties held in Sarajevo (Bosnia and Herzegovina) on October 24, 2019.

Acknowledgements

The Sava Flood Risk Management Plan represents a true collective effort that reflects cooperation in flood risk management in the Sava River basin and beyond. Many institutions and individuals, in different ways, contributed to the preparation of this Plan.

Special acknowledgments should be given to:

- ✓ the Permanent Expert Group for Flood Prevention (PEG FP) of the International Sava River Basin Commission (Sava Commission): Dragana Milovanović (chairperson), the members Almir Bajramlić, David Latinović, Amer Kavazović, Sanda Buconjić-Kolarić, Miro Macan, Sandra Sokolić, Danko Biondić, Darko Barbalić, Merita Borota, Darko Janjić, Božidar Beloš, Marina Babić-Mladenović, Luka Štravs, Bojan Jakopič, Blažo Đurović, Marijan Babić; Mirza Sarač, Advisor for protection against detrimental effects from waters and extraordinary impacts on the water regime in the ISRBC Secretariat; as well as national expert Dragana Djukić, for the overall guidance of the project team, facilitating data collection at both the basin-wide and national level, valuable comments to the structure and text of the Plan;
- ✓ the Sava Commission Secretariat for facilitation and overall coordination of the Plan development;
- ✓ Dragan Zeljko, Sava Commission Secretary, for the support to the development of the Plan and his personal contribution to the activities that preceded the development of the Plan;
- ✓ the project "Improvement of joint Flood Management Actions in the Sava River Basin", component 1 "Development of the Sava Flood Risk management Plan" approved by Western Balkans Investment Framework and implemented by World Bank for providing technical support and to the members of the project team Boris Šćekić, Višnja Omerbegović, Predrag Srna, Nijaz Lukovac, Davorin Singer, Branislav Sekulović, Đorđe Mitrović, Duška Kunštek and Zoran Bogunović for coordinating the data collection efforts, developing methodologies, performing analysis and drafting major parts of the text;
- ✓ the members of the expert groups of the Sava Commission in general and PEG GIS and PEG RBM for the support in the development of this Plan;
- ✓ institutions, organizations, and individuals for its active cooperation during the process of the development of the Plan;
- ✓ the observers at the Sava Commission for its contribution to the process of the development of the Plan by providing comments during the process of the public information and consultation;
- ✓ the Secretariat of International Commission for the Protection of the Danube River (ICPDR) for its support.

Special thanks go to the Western Balkans Investment Framework for financial support to the Plan preparation and World Bank for administration of the project, specifically to Igor Palandžić for his contribution during the development of the Plan.

Disclaimer

The Flood Risk Management Plan in the Sava River Basin (Sava FRMP) is based on data delivered by the Parties to the Framework Agreement on the Sava River Basin (Bosnia and Herzegovina, Republic of Croatia, Republic of Serbia and Republic of Slovenia) and Montenegro, which joined the activities of the International Sava River Basin Commission by signing the Memorandum of Understanding on cooperation between the International Sava River Basin Commission and Montenegro on the 9th of December 2013 in Belgrade[1]. Where needed, other data sources have been used. Sources other than the competent authorities have been clearly identified in the Plan.

A more detailed level of information is presented in the national Flood Risk Management Plan of the Republic of Slovenia and in the River Basin Management Plan of the Republic of Croatia which contains Flood Risk Management Plan for the period 2016 – 2021, as European Union Member States.

An overall contribution to the development of Sava FRMP and data contained within was provided by the experts from institutions listed below: Slovenia: Ministry of the Environment and Spatial Planning; Croatia: Ministry of Environment and Energy and Croatian Waters; Bosnia and Herzegovina: Ministry of Foreign Trade and Economic Relations of BiH, Federal Ministry of Agriculture, Forestry and Water Management, Ministry of Agriculture, Forestry and Water Management of Republika Srpska, Sava River Watershed Agency Sarajevo, Public Institution "Vode Srpske" Bijeljina; Serbia: Ministry of Agriculture, Forestry and Water Management – Republic Water Directorate, Public Water Management Company „Srbijavode"[2], Public Water Management Company „Vode Vojvodine" and Institute for the Development of Water Resources "Jaroslav Černi"; Montenegro: Ministry of Agriculture and Rural Development – Directorate for Water Management and Water Administration.

Some countries were not able to provide all the information needed for this Plan and these data gaps are noted in the text. Where data has been made available, it has been examined and is presented to the best of available knowledge. Nevertheless, inconsistencies cannot be ruled out.

Given the complexity of all aspects of flood risk management in the Sava River Basin and various legal frameworks, this document is not fully aligned with all national documents, Directive on the Assessment and Management of Flood Risks and other valid documents. For this reason, if there are differences in this document in relation to national valid documents or if there are differences in the interpretation of this document, relevant national documents will be considered valid at that time as well as the interpretations that follow from the valid national documents. For the same reason, for all activities, measures and obligations arising out of this document and not foreseen in the applicable national documents, it is necessary to fully align them with national legal frameworks, available flood risk management instruments and to carry out their more detailed elaboration at national and bilateral levels in accordance with the law defined by the national procedure for their acceptance.

[1] https://www.savacommission.org/event_detail/1/26/303

[2] In March 2017, PWMC "Srbijavode" took over management of water land and facilities on category I waters from PWMC "Beogradvode"

Structural measures in areas of mutual interest for flood protection at the Sava River Basin level (AMIs) are presented in Sava FRMP on the basis of national flood risk management plans (HR, SI), as well as planning and strategic documents (BA, ME, RS). The national measures presented herein contribute to reducing the chance of duplication of works for the purpose of reducing the risk and mitigating consequences of flooding at the Sava River Basin level. Taking into account that the summary of structural measures in Sava FRMP is compiled on the basis of measures defined at national level and according to different procedures, it is necessary to implement them in accordance with national and international regulations, and nationally planned schedule established by the activity promoter.

Non-structural measures contain activities conducted by individual countries, as well as activities that have been evaluated as measures of interest at the basin level during the preparation of the Plan. Implementation of non-structural measures will be carried out in accordance with the planned schedule of the proposed promoters of specific activities.

Table of Contents

List of Tables

List of Figures and Maps

List of Acronyms

AL	ISO code for Albania
BA	ISO code for Bosnia and Hercegovina
BD	Brcko District BiH
BiH	Bosnia and Hercegovina
CBA	Cost Benefit Analysis
CCA	Climate Change Adaptation
DRR	Disaster Risk Reduction
EEA	European Environmental Agency
EU	European Union
FASRB	Framework Agreement on the Sava River Basin
FBiH	Federation of Bosnia and Herzegovina
FD	Directive 2007/60/EC on the assessment and management of flood risks - Floods Directive
FFWS	Flood Forecasting and Warning System
FHM	Flood Hazard Maps
FRM	Flood Risk Maps
FRMP	Flood Risk Management Plan
GEF	Global Environment Facility
GHG	Green House Gases
GIS	Geographic Information System
HR	ISO code for Croatia
ICPDR	International Commission for the Protection of the Danube River
ISRBC	International Sava River Basin Commission
ME	ISO code for Montenegro
PEG FP	Permanent Expert Group for Flood Prevention
PFRA	Preliminary Flood Risk Assessment
APSFR	Area with Potentially Significant Flood Risk
RBMP	River Basin Management Plan
RS	ISO code for Serbia
SI	ISO code for Slovenia
SRBA	Sava River Basin Analysis
UNECE	United Nations Economic Commission for Europe
WB	The World Bank
WBIF	Western Balkans Investment Framework

1 Introduction

1.1 Background

The Framework Agreement on the Sava River Basin[3] (hereinafter: FASRB), implementation of which is coordinated by the International Sava River Basin Commission (hereinafter: Sava Commission or ISRBC), established conditions for drafting the Flood Risk Management Plan in the Sava River Basin (hereinafter: Sava FRMP). Conditions and elements for drafting Sava FRMP were set in detail in the Protocol on Flood Protection to the FASRB (hereinafter: the Protocol).

Sava FRMP has been partially aligned, to the extent possible, with the requirements of the Directive 2007/60/EC of the European Parliament and Council on 23 October 2007 on the assessment and management of flood risk (hereinafter: Flood Directive), which sets legal basis for reduction and management of flood risks to human health, environment, cultural heritage and economic activity.

The purpose of drafting Sava FRMP is to establish joint objectives of flood risk management in compliance with principles of long-term sustainability, identify non-structural measures and structural measures in areas of mutual interest, and enable consistent and coordinated approach in managing these risks at the level of entire Sava River basin.

The objectives of drafting the joint Flood Risk Management Plan in the Sava River Basin are:

- avoidance of new risks;
- reduction of existing risks;
- strengthening resilience;
- raising awareness;
- implementing solidarity principle.

Sava FRMP has been developed based on the first national flood risk management plans of Slovenia and Croatia, draft flood risk management plan for the Republic of Serbia, water management strategies of four countries in the Sava River basin: Bosnia and Herzegovina, Croatia, Slovenia and Serbia (hereinafter: Parties to the Framework Agreement or Parties), as well as Montenegro, which joined the activities of the Sava Commission by signing the Memorandum of Understanding on cooperation between the International Sava River Basin Commission and Montenegro, laws and regulations, and other documents relevant for flood risk management in the Sava River basin.

The list of laws and regulations, national strategic documents, detailed plans and programs, as well as national documents, studies, reports and other documents of importance for drafting the Sava FRMP, is presented in Chapter 11.

[3] http://www.savacommission.org/dms/docs/dokumenti/documents_publications/basic_documents/fasrb.pdf

1.2 Basis for development of Sava FRMP

Multilateral Framework Agreement on the Sava River Basin entered into force in 2004, and for the Parties it represents a foundation for cross-border cooperation of governments and institutions on sustainable regional development through cross-border cooperation in water management.

FASRB defines three main objectives of cooperation:

- establishment of an international regime of navigation on the Sava River and its navigable tributaries;
- establishment of sustainable water management;
- undertaking of 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.

The Sava Commission, established for the purpose of the implementation of the Framework Agreement, with a permanent Secretariat in charge of administrative and executive tasks, is competent for making decisions in the field of navigation and making recommendations on water management issues.

The need for improved cooperation and implementation of jointly agreed activities focused on providing conditions for sustainable protection against floods in the basin, resulted in development of the Protocol on Flood Protection to the FASRB[4] (hereinafter: The Protocol). The Protocol emphasises the importance of establishing coordinated measures, works and activities aimed at flood risk reduction at the basin level, as well as implementation of those activities in accordance with the no-harm principle. In order to contribute to reduction of harmful consequences of floods, especially for human life and health, environment, cultural heritage, economic activities and infrastructure, the Parties agreed by adopting the Protocol to cooperate on implementation of the listed activities.

The Protocol is the basis for implementation of all activities agreed by the Sava countries through their joint platform – the Sava Commission. In order to achieve objectives set in the Protocol, based on Article 4 the Parties have undertaken to cooperate on:

a) preparation of the Program for development of Flood Risk Management Plan in the Sava River Basin;
b) undertaking of Preliminary Flood Risk Assessment (hereinafter: PFRA);
c) preparation of Flood Hazard and Risk Maps (hereinafter: FHRM);
d) development of Flood Risk Management Plan in the Sava River Basin, initiated with the development of the Program;
e) establishment of the Flood Forecasting and Warning System for the Sava River Basin (hereinafter: FFWS);
f) exchange of information significant for sustainable flood protection;

[4] http://www.savacommission.org/dms/docs/dokumenti/documents_publications/basic_documents/protocols/protocol_on_flood_protection_to_the_fasrb.pdf

g) implementation of all measures and activities of mutual interest, originating from planning documents or activities from items a) to f) above or other mutually agreed measures and activities.

The Protocol was signed by all parties in 2010, and entered into force on 27 November 2015.

Important steps in terms of Protocol implementation were made even before formal entrance into force through conclusions of the Sava Commission, expressed need of the Parties to implement joint activities agreed on the 3rd, 4th and 5th Meetings of the Parties (in Ljubljana on 1 June 2011, Sarajevo on 31 May 2013, and Zagreb on 2 December 2014), at the Ministerial meeting on regional cooperation in the field of flood protection in the Sava River Basin (16 June 2014 in Belgrade), and at the Ministerial meeting on regional cooperation in the field of water management (in Brčko on 6 July 2015).

The 6th Meeting of the Parties was held on 1 June 2016 in Belgrade. The main goal of the meeting was to review the progress on FASRB implementation, as well as key challenges in the forthcoming period, with the special attention given to issues of sustainable development and guidelines for further cooperation within the Sava Commission framework. Two years later, during the 7th Meeting of the Parties (on 7 June 2018 at Bled) discussed was progress in further implementation of the FASRB, especially regarding the basin management, flood risk management, and information exchange relevant for the whole basin. As in case of previous Meetings of the Parties, a Declaration was adopted as a concluding act that included support of the Parties to all activities aimed at successful completion and adoption of Sava FRMP.

Development of Sava FRMP started with the preparation of the Program for development of Flood Risk Management Plan in the Sava River Basin (hereinafter: the Program)[5]. The Program stipulates activities and actions needed for the development of Sava FRMP in accordance with the Protocol, taking into account already completed or ongoing activities of Parties and at the level of the entire basin. The Program was adopted in February 2017, at the 44th Session of the Sava Commission.

An important basis for flood risk management planning and Sava FRMP preparation is regular exchange of information on projects and activities related to flood management through the work of Permanent Expert Group for Flood Prevention (hereinafter: PEG FP).

The following documents were also important for the development of Sava FRMP:

- Action Plan for the Sava River Sub-Basin as part of the Action Programme for Sustainable Flood Prevention in the Danube River Basin[6], which was developed in coordination with International Commission for the Protection of the Danube River (hereinafter: ICPDR) in 2009. The Action Plan contains a comprehensive study on flood management in the Sava River basin, provides key information on flood prone areas, thoroughly describes flood defence systems, including criteria and current level of protection, as well as overview of capacities for flood forecasting, reviews

[5] Draft Program was one of the main deliverables of the project "Linking the flood risk management planning and assessment of climate change in the Sava River Basin". The project was funded by the United Nations Economic Commission for Europe (UNECE), and implemented by the Sava Commission in the 2010-2013 period.

[6] http://www.savacommission.org/dms/docs/dokumenti/documents_publications/publications/other_publications/flood_action_plan_sava_river_basin.pdf

management responsibilities in the countries, and provides an overview of joint activities coordinated by the Sava Commission;

- Preliminary Flood Risk Assessment in the Sava River Basin[7] in 2014, based on information gathered by the Parties about the results of their preliminary flood risk assessments and definition of areas with potentially significant flood risks;
- Report on floods in the Sava River Basin in May 2014[8], with an overview of causes and consequences of the catastrophe that had affected about 2.64 million people, with about 137,000 evacuated, 79 victims and € 3.9 billion in damages and losses. The report provides recommendations for flood risk management in the future.

In the 1st Sava River Basin Analysis (hereinafter: 1st SRBA)[9], adopted by the ISRBC in 2009, as well as the 2nd Sava River Basin Analysis (hereinafter: 2nd SRBA)[10], adopted in June 2017, floods were recognised as a very important integration issue.

1.3 Structure of the Flood Risk Management Plan in the Sava River Basin

Sava FRMP was developed within the first cycle of flood risk management and will be, as required, updated every six years after its adoption, taking as a starting point the relevant national plans.

Pursuant to the provisions of Article 8, point 1 of the Protocol, Sava FRMP is prepared in accordance with the content defined in the Program, and taking into account all relevant aspects of flood risk management.

Sava FRMP has been developed for areas of mutual interest for flood protection in the basin, which includes sub-basins shared by two or more countries[11], as well as areas within territories of one country proposed by that country as significant for flood protection on main Sava watercourse or its tributaries with basin surface of more than 1,000 km^2. Structure of Sava FRMP (Figure 1) is determined by the Program, and follows the logic and requirements of the Floods Directive.

Development of Sava FRMP was preceded by analyses of components and elements of the national flood risks management plans for those countries which had developed them, or relevant strategic documents and plans for the countries that had not yet developed such plans, so as to enable comparative analysis and prepare the starting point for providing harmonised joint proposals and recommendations for each individual plan component, including approaches and methodologies.

---

[7] http://www.savacommission.org/dms/docs/dokumenti/documents_publications/publications/other_publications/pfra/preliminary_flood_risk_assessment_in_the_sava_river_basin_20140701.pdf

[8] http://www.savacommission.org/dms/docs/dokumenti/documents_publications/publications/other_publications/sava_floods_report.pdf

[9] http://www.savacommission.org/dms/docs/dokumenti/documents_publications/publications/other_publications/sava_river_basin_analysis_report_low_res.pdf

[10] http://www.savacommission.org/dms/docs/dokumenti/documents_publications/publications/other_publications/2nd_sava_river_basin_analysis_report.pdf

[11] The threshold value for planning at the level of the Sava River Basin in terms of the size of the river catchments is 1,000 km^2, as agreed upon during the development of the 1st Sava RBMP, with exemption of the rivers with smaller catchment areas but designated as being of basin-wide importance. This principle is generally respected in the Sava FRMP, subject to certain exceptions which are agreed through the work of PEG FP.

The Sava FRMP includes in particular:

- Objectives of flood risk management of mutual interest at the Sava River basin level, with the aim of reducing possible negative consequences of floods to human health and life, their property and economic activities, environment, and cultural-historic heritage;
- Non-structural measures and structural measures in areas of mutual interest, taking into account the solidarity principle and the non-harm principle, according to which one country cannot apply measures that can, by their scope or impact, significantly increase flood risks in another country. For all measures in this Plan, it is necessary to undertake national and, if required, international procedures for their approval, and establish bilateral agreements if such measures will have an effect on neighbouring countries;
- Coordination mechanisms for flood risks management at the Sava River basin level and manners of cooperation in case of flood defence emergency situations.

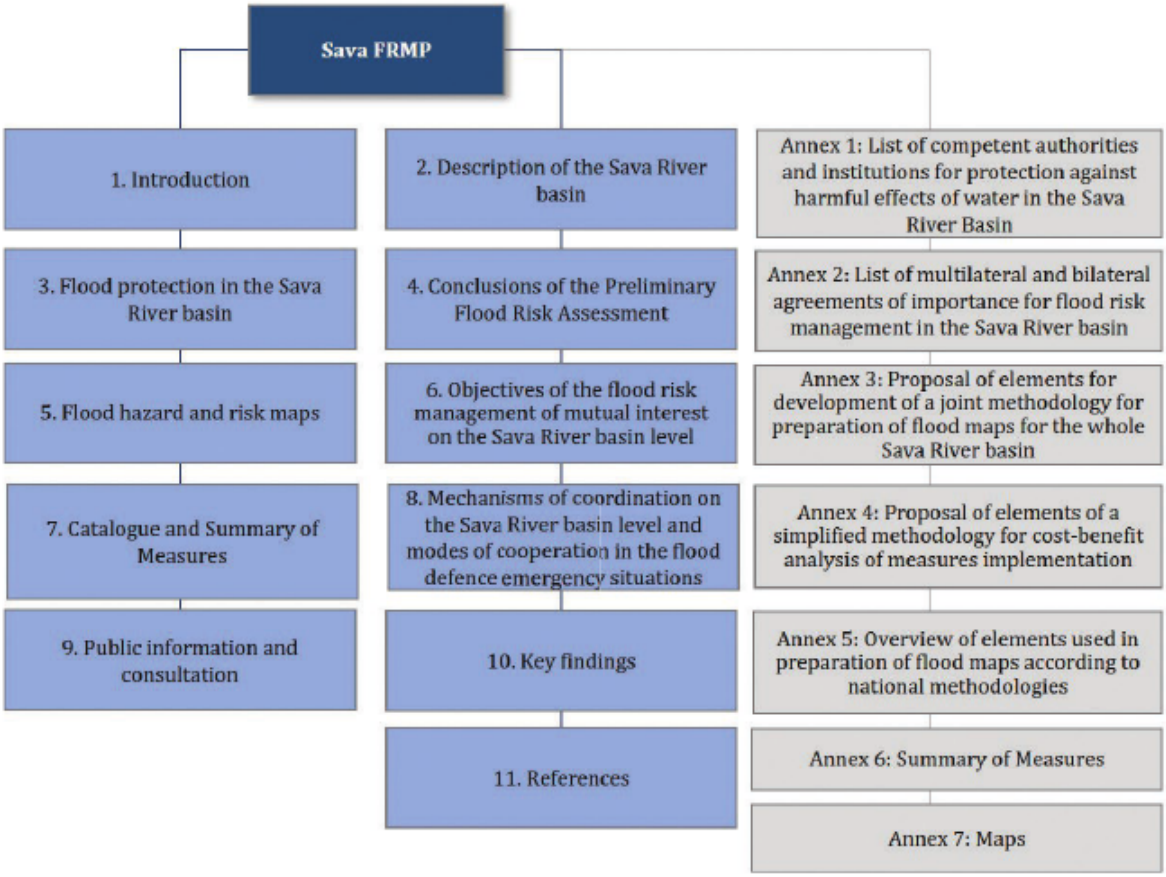


Figure 1: Structure of Sava FRMP

2 Description of the Sava River basin

2.1 Relief and topography

The relief of the Sava River basin is composed of mountainous sections (Alps and Dinaric Alps), dominating in Slovenia, southern part of Croatia, Bosnia and Herzegovina, Serbia, Montenegro and northern Albania (Figure 2). Northern parts of middle and lower Sava River course are characterised by low forests and lowlands. This area is part of Pannonia and Posavina (Croatia, Bosnia and Herzegovina and Serbia), i.e. a lowland agricultural area.

The altitude of the Sava River basin varies between app. 70 m.a.s.l. at the confluence of Sava in Belgrade (Serbia), and 2,864 m.a.s.l. (Triglav, Julian Alps). The average altitude of the basin is about 545 m.a.s.l.

Difference in landscape of the northern and southern parts of the basin is visible especially in the middle part. Southern part is hilly and mountainous, with mountains reaching over 2,000 m.a.s.l, especially in Montenegro and northern Albania.

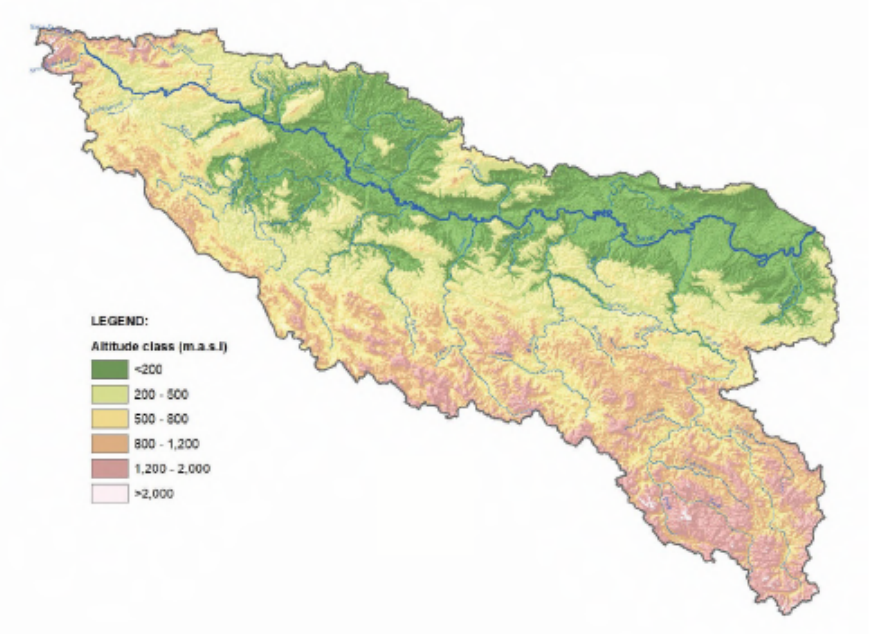


Figure 2: Relief of the Sava River basin (source: ISRBC, Sava GIS)

From hydrographic and hydrological aspects, karst nature of the basin is most prominent in the southern part of the basin, which applies to right tributaries of the Ljubljanica, Krka, Kupa, Una, Vrbas and upper courses of the Bosna and the Drina rivers.

2.2 Land cover / land use in the basin

Based on the data for Europe prepared by the European Environmental Agency (EEA) for the Corine land cover/use (hereinafter referred to as: Corine) in the period of 2000 – 2006 – 2012 (Figure 3), it can be concluded that share of artificial areas, forests and semi-natural

areas and wet lands is slightly increasing, while agricultural lands and in-land water areas show a trend of slight decrease.

Figure 3: Land cover / land use in the Sava River basin (source of data: EEA, Corine database for Europe and ISRBC, Sava GIS)

Table 1: Distribution of main categories of land coverage in the Sava River basin (source: ISRBC, 2nd SRBA)

Land class	Corine 2000		Corine 2006		Corine 2012	
	Area (km^2)	Share (%)	Area (km^2)	Share (%)	Area (km^2)	Share (%)
Artificial surfaces	2,179	2.23	2,415	2.48	2,451	2.52
Agricultural areas	41,381	42.36	40,215	41.26	40,178	41.22
Forests and semi natural areas	53,459	54.71	54,111	55.52	54,117	55.53
Wetlands	78	0.08	90	0.09	91	0.09
Inland waters – water bodies	616	0.63	632	0.65	625	0.64

2.3 Hydrographic and hydrologic characteristics

2.3.1 Sava

The Sava River basin is the main basin of South-East Europe, spreading over a total area of about 97,700 km^2. It is one of the most important sub-basins of the Danube basin, making 12% thereof. The Sava River is created from the Sava Dolinka and Sava Bohinjka near

Radovljica in Slovenia. From the confluence of these two rivers, the Sava is 945 km long. Together with its longer headwater, Sava Dolinka River in the north-west, it measures 990 km.

The Sava flows into the Danube in Belgrade. In terms of length it is the third, in terms of basin area second, and in terms of flow the first and biggest Danube tributary. In one part it forms the border between Slovenia and Croatia, then between Croatia and Bosnia and Herzegovina, as well as between Bosnia and Herzegovina and Serbia.

The entire course of the river is divided into 3 sections:

- Upper Sava, between the confluence of Sava Dolinka and Sava Bohinjka and Rugvica (658[12] km). In this part of the river, the relief is hilly and mountainous;
- Middle Sava, between Rugvica and confluence of the Drina River (178 km), is a lowland alluvial section characterised by wide floodplains and confluences of numerous tributaries;
- Lower Sava downstream from the mouth of the Drina River, is also an alluvial section. The most downstream section is 100 km long, and under influence of the Danube.

The basin is divided among six countries: Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Montenegro and Albania.

Figure 4: Sub-basins of the Sava River – per Sava country (source: ISRBC, Sava GIS)

Within the territory of five countries in the region (Albania is not included since only a negligible part of the basin belongs to the country) there are about 18 million inhabitants, a half of which live in the Sava River basin. In Slovenia, 61% of people live within the Sava

[12] Measured from the Sava River mouth

River basin, 50% in Croatia, 88% in Bosnia and Herzegovina, 26% in Serbia, and about 33% in Montenegro.

Table 2 contains an overview of countries' share in the Sava River basin territory.

Table 2: Countries' share in the Sava River basin territory (source: ISRBC, 2nd SRBA)

	SI	HR	BA	RS	ME	AL
Total area of the country [km²]	20,273	56,542	51,129	88,361	13,812	27,398
Area of the country in the Sava River Basin [km²]	11,734	25,373	38,349	15,147	6,929	179
Share in international Sava River Basin [%]	12.01	25.97	39.25	15.50	7.09	0.18

The most obvious detail on the longitudinal profile of the Sava River (Figure 5) is the sharp change in the channel slope (knickpoint) near the City of Zagreb. Upstream of the hydrological station Radovljica, average longitudinal slope of the Sava River is close to 10‰ (this section of Sava River definitely has a torrential nature). Between Radovljica and Rugvica (658 km), the slope drops to ~ 2‰, to go even lower to ~0.05‰ between Rugvica and Belgrade. Increase in slope upstream is common characteristic of all tributaries.

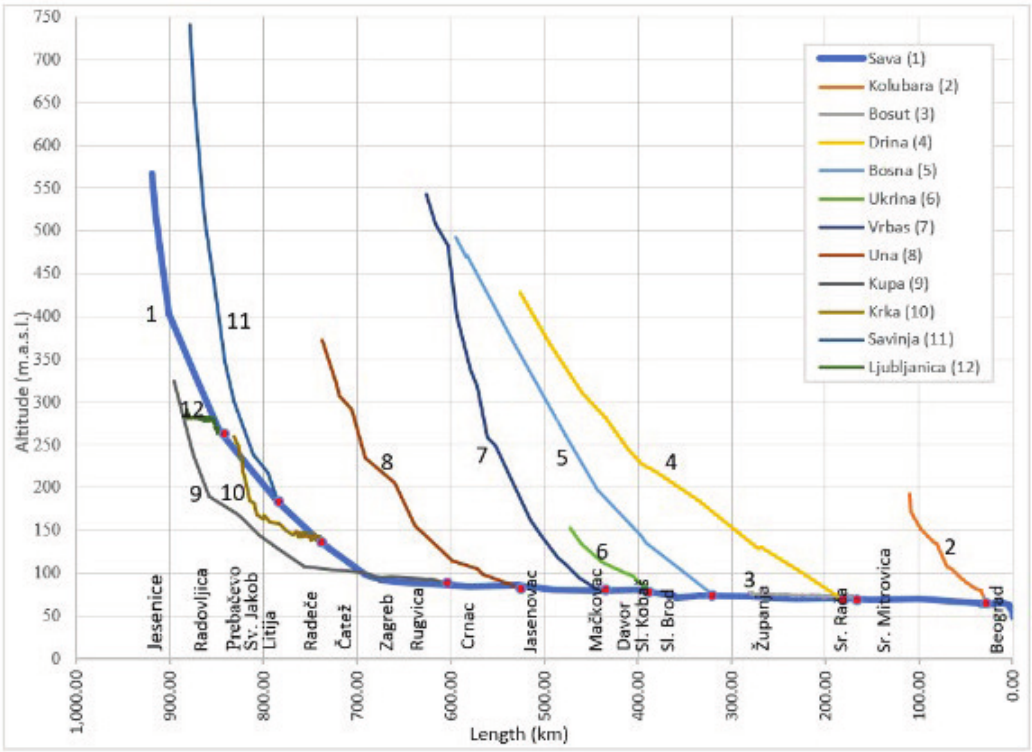


Figure 5: Schematic overview of longitudinal profiles of the Sava and its tributaries

2.3.2 Tributaries of the Sava River significant for Sava FRMP preparation

Tributaries of the Sava River significant for Sava FRMP preparation are shown in Table 3. The most important tributaries in the upper part of the Sava River are: Tržiška Bistrica, Kokra, Kamniška Bistrica, Savinja, Sutla and Krapina (from the left side), and Sora, Ljubljanica, Krka and Bregana (from the right side). A common characteristic of almost all right hand tributaries in middle and lower course of Sava is their torrential nature, especially in their upper sections. Riverbeds are usually deeply cut into solid rocks, with excessively strong course through gorges.

Important right hand tributaries of middle and lower Sava include: Kupa, Una with its tributary Sana, Vrbas, Ukrina, Bosna, Lukavac, Tinja and Brka on the middle section; and Drina with tributary Piva, Tara, Ćehotina, Lim with Uvac, and Kolubara and Topčiderska reka on the lower section.

Left hand tributaries on the middle and lower Sava are Lonja, Ilova, Orljava and Bosut, mainly drained by plains and lowlands of the Pannonia plain. Consequently, slopes and velocity of the rivers are lower and watercourses meandered.

Table 3: Sava river tributaries significant for Sava FRMP preparation

River	Basin Surface (km^2)	River Length (km)	Countries sharing the sub-basin	Tributary class	Sava tributary L-left R-right
Tržiška Bistrica	146	27	SI	1	L
Kokra	222	34	SI	1	L
Sora	648	52	SI	1	R
Kamniška Bistrica	539	33	SI	1	L
Ljubljanica	1,860	40	SI	1	R
Savinja	1,849	93.6	SI	1	L
Krka	2,247	94.7	SI	1	R
Sotla/Sutla	584	89.7	SI, HR	1	L
Bregana	92	26	SI, HR	1	R
Krapina	1,237	66.87	HR	1	L
Kupa/Kolpa	10,226	118.3	SI, HR, BA	1	R
Lonja	4,259	47.95	HR	1	L
Ilova (Trebež)	1,796	104.56	HR	1	L
Una	9,829	157.22	HR, BA	1	R
Sana	4,253	141.1	BA	2	R
Vrbas	6,274	235	BA	1	R
Orljava	1,618	93.44	HR	1	L
Ukrina	1,504	80.9	BA	1	R
Bosna	10,810	272	BA	1	R
Lukavac	462	55.8	BA	1	R
Tinja	904	88.1	BA	1	R
Brka	231	41.3	BA	1	R
Drina	20,320	335.67	ME, BA, RS	1	R
Piva	1,784	43.5	ME, BA	2	L
Tara	2,006	134.2	ME, BA	2	R
Ćehotina	1,237	118.66	ME, BA	2	R
Lim	5,968	278.5	AL, ME, RS, BA	2	R
Uvac	1,596	117.7	RS, BA	3	R

River	Basin Surface (km^2)	River Length (km)	Countries sharing the sub-basin	Tributary class	Sava tributary L-left R-right
Bosut	2,943	132.18	HR, RS	1	L
Topčiderska reka	147	29	RS	1	R
Kolubara	3,638	86.7	RS	1	R

2.3.3 Climate

The Sava River basin is mainly characterised by moderate climate with clear distinction between cold and hot seasons. Winters can be severe with a lot of snow, while summers are hot and long. There are two general types of climate conditions in the basin:

- Alpine or mountainous climate, prevailing climate in the upper part of the Sava River basin in Slovenia and in highlands of the Dinaric Alps;
- Moderate continental or mid-European climate, prevailing in the lower lands of the basin, including the Pannonia plain.

There are no clear dividing lines between these climate types.

The average annual air temperature for the entire Sava River basin is estimated at about 9.5°C. Winter temperatures (December – February) are low (average monthly temperature in January goes down to about -1.5°C), while in summer (June – September) are high (almost 20°C average).

2.3.4 Precipitation and runoff

There are two precipitation regimes recognised in the Sava River basin: marine and continental ones. The marine regime is characterised by greater quantities of rainfall in winter period (October – March), while in continental regime, the maximum is reached in warmer period of a year (April – September).

Quantities of precipitation and the annual distribution vary considerably and have a common characteristic: both rainfall and snow of different duration can appear throughout the entire basin. Average annual rainfall in the Sava River basin are estimated at about 1,100 mm. Quantities and distribution of rainfall in a year are variable within the basin, and they range between 650 mm in lower and 1,000 mm in higher altitudes, reaching up to 4,000 mm in highest mountains. While Slovenian part of the basin records greatest quantities of rainfall in summer or autumn season, other seasons under snow result in relatively high degree of drainage in spring time, and in early summer season; in the Pannonia plain, the greatest quantities of rainfall are recorded in warmer part of a year.

Spatial distribution of precipitation, as the main element contributing to the formation of flood waves in the Sava River basin, is heterogeneous. Precipitation is most abundant in western parts (Sava Dolinka and Sava Bohinjka), and in the upper parts of Kupa, Piva, Tara, Una, Vrbas, Drina and Lim. Areas with lowest quantities of precipitation are Slavonia, Syrmia and Semberia. Spatial distribution of runoff to great extent follows the pattern of spatial distribution of precipitation.

The greatest quantities of precipitation and water in general can be found in the upper basins of right tributaries: Krka, Kupa, Una, Vrbas, Bosna and Drina. Average long-term

annual discharge of the Sava River near Belgrade is about 1,700 m^3/s. Figure 6 gives an overview of 100-year maximum annual flows according to measuring stations, prepared based on results of previous studies that analysed high flows.

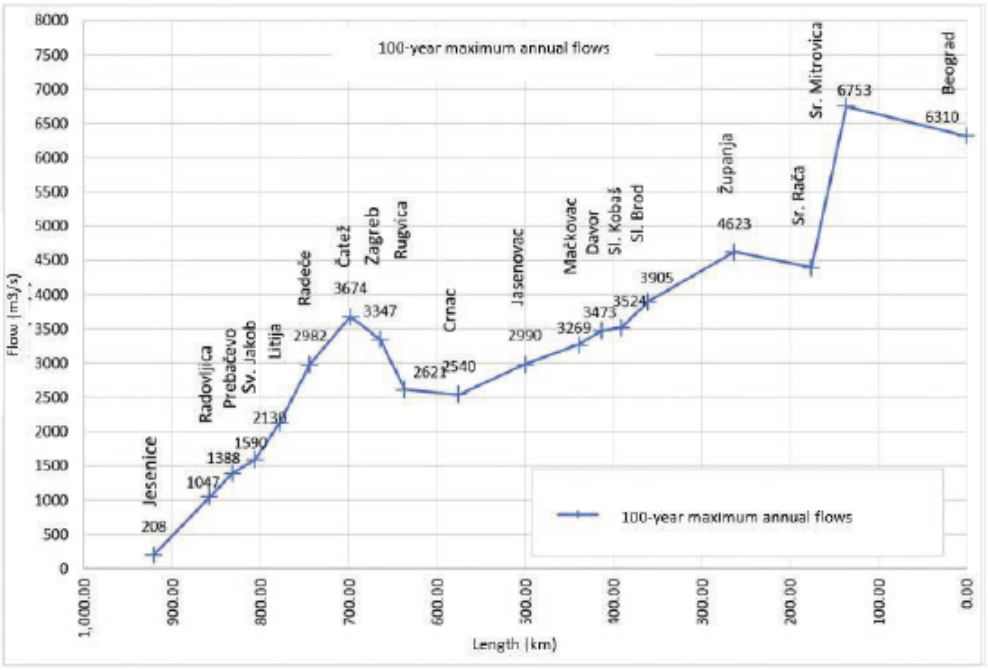


Figure 6: Overview of 100-year maximum annual flows in the main Sava River

3 Flood protection in the Sava River basin

3.1 High waters and significant floods

Occurrence and characteristics of high waters in the Sava River basin are greatly influenced by the basin features and shape, geographic and precipitation distribution season, the ground water level which affect infiltration of river, overflow of high waters into natural inundations and by functioning of the flood protection systems.

Taking into account features of the terrain, intensive rainfall and snow melting in the upper parts of the basin, mainly belonging to Slovenia, there are frequent floods with local character, but quite often they impact downstream parts of the middle course of the Sava River. The shape of the basin is asymmetrical with respect to the Sava River watercourse, where greater part is drained by tributaries from the mountainous area.

Although historic floods indicate that lowland areas along the Sava River left tributaries in the middle course can suffer from significant damage, greater floods with significant impact to most of the basin include floodplains in the middle and lower parts of the Sava River, and they are conditioned by runoff caused by abundant rainfall and/or abrupt snow melting which occur in southern mountainous area (sub-basin of Kupa, and especially of Una, Vrbas, Bosna and Drina). Flood events caused by high water waves in the Sava River basin usually occur in autumn and spring. The autumn water waves are usually caused by intensive short rains, and can result in extreme high flows. Longer spring flood waves are a result of snow melting, while over the past several years, spring flood events are quite frequent, caused by intensive short and long rains (e.g. event from May 2014).

Bearing in mind weather differences between the occurrence of high waters in the main watercourse of the Sava River and its tributaries, historic experience demonstrates that maximum flows during high waters at the mouths of right-hand tributaries reach Sava before the occurrence of maximum flows in the Sava River itself.

A specific problem in the basin includes numerous torrential watercourses, which in the high waters runoff carry huge quantities of material, which is deposited in riverbeds and prevents regular flow. A significant part of the basin surface is under threat of erosion.

Earliest recorded floods in the Sava River basin were in 1550 in Slovenia. In XVIII century in Slovenia three floods were recorded: 1704, 1707, and 1772. Figure 7 shows recorded flood events in Slovenia in 1824 to 1924 period, on Drina in 1896, as well as events for all other Sava River countries in 1924 to 2014 period. It can be concluded that during the period of XX - XXI century there was at least one recorded flood each ten years, except in the 1834-1844 period, while in the 1994 to 2004 period larger floods were recorder in the basin each year.

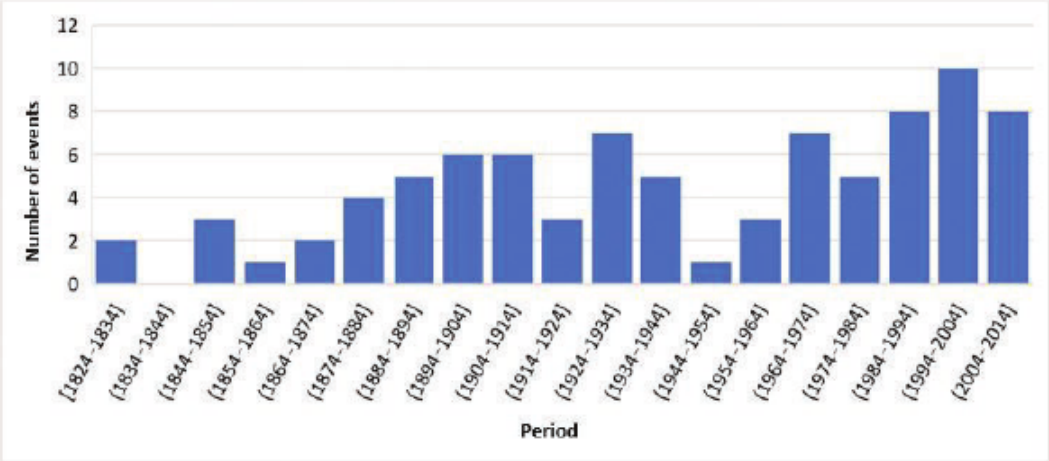


Figure 7: Number of recorded flood events from XIX to XXI century

In May 2014, the Sava River basin, mostly areas in Croatia, Bosnia and Herzegovina and Serbia, was affected by an unprecedented flood event, described in a Report prepared by ISRBC and ICPDR[13]. Table 4 contains data about damages and losses suffered by countries affected by this flood event.

Table 4: Overview of damages and losses in countries affected by the floods in May 2014
(Source: ISRBC and ICPDR – 2014 Floods in the Sava River Basin)

Country	Affected population (mil.)	Evacuated population	Casualties	Total damage (mil. €)	Cause
Serbia	1.6	32,000	51	1,532	Torrents, landslides, breach of dykes
Bosnia and Herzegovina	1	90,000	25	2,037	Torrents, landslides, breach of dykes
Croatia	0.38	15,000	3	300 (refers only to Vukovarsko-Srijemska county)	Breach of dykes

3.2 Potential flood areas

During the preparation of Sava FRMP, taken into account were potential flood areas defined in the Preliminary Flood Risk Assessment for the Sava River basin (hereinafter: Sava PFRA, 2014), as well as additional national documents, primarily for part of areas in Bosnia and Herzegovina (entities of Republika Srpska and Brčko District BIH), and areas in Montenegro, which weren't included in the Sava PFRA report.

[13] Complete report about this event is available at: http://www.savacommission.org/dms/docs/dokumenti/documents_publications/publications/other_publications/sava_floods_report.pdf

The total surface of all 1,926 considered potential flood areas is about 18,850 km² with a population of approx. 4.4 million. Within that surface, 10,600 km² is agricultural land, about 6,900 km² are forests and semi-natural areas, approx. 1,000 km² artificial surfaces, and the remainder of about 350 km² is made of wetlands and water surfaces.

Based on available data and undertaken analyses, 251 potential flood areas were identified as important for Sava River basin, with a total area of 5,659.29 km² (Table 5), which is 5.8 % of total area of the basin (97,700 km²) and 30.1 % of the total area of all analysed potential flood areas. The identified potential flood areas are home to about 1.4 million inhabitants, which is 16.2% of total population in the Sava River Basin (8,640,000, source: 2nd SRBA). Land use was analysed using land cover data from Corine (EEA, 2012), which indicates that about 3,620 km² of agricultural land are under potential threat, as well as about 1,555 km² of forests and semi-natural areas, 310 km² of artificial areas and 29 km² of wetlands. About 144 km² of water surfaces are estimated to be present.

Table 5: Overview of identified potential flood areas important for flood protection in the Sava River basin

(surface, population, and land use)

Country	Number of potential flood areas important for the Sava River basin	Total surface of potential flood areas (km²)	% compared to total surface of the basin	Population in the affected area	Land use (km²)				
					Agricultural land	Forests and semi-natural areas	Artificial surfaces	Wetlands	Water surfaces
SI	64	128.13	0.13	20,917	48.09	74.20	4.097	0.71	1.04
HR	129	1,596.92	1.63	149,973	807.63	673.27	58.10	10.15	47.13
RS	7	2,812.09	2.88	821,559	1,862.44	697.07	186.36	16.28	49.95
BA	46	1,094.63	1.12	316,483	889.28	102.27	55.62	1.58	45.89
ME	5	27.52	0.03	57,844	13.46	8.042	5.75	0.00	0.28
Total	**251**	**5,659.29**	**5.79**	**1,366,776**	**3,620.90**	**1,554.85**	**309.92**	**28.72**	**144.29**

3.3 Flood protection structures

Dykes along the Sava River, constructed with differently designed protection levels, and reservoirs, retention areas and diversion channels are used for improving flood protection in the Sava River basin.

3.3.1 Dykes, retention areas, riverbed regulation, diversion channels

A summary of constructed flood protection systems and structures on Sava River and its tributaries is given below, taking into account size and importance of the areas protected by these systems, as well as positive effects of certain systems and structures on flood protection downstream.

Figure 8 shows flood protection structures along the Sava and its tributaries, based on available data in the SavaGIS database (dykes, pumping stations, weirs and dams).

Development of hydro powerplants on the Sava in Slovenia included construction, reconstruction and maintenance of new water infrastructure – dykes and reservoirs for the flood protection of settlements. Most of the dykes along the Sava River are built near Krško, Brežice and Čatež, on Savinja above Celje, and along Tržiška Bistrica.

Existing flood protection systems in the Sava River basin in Croatia are very complex and they include large number of riverbed regulations and flood protection structures. The City of Zagreb is properly protected against high waters of Sava River, and estimated to be protected from the high waters of 1,000-year return period. Upstream from Zagreb, towards the Slovenian border, flood protection dykes are only partially constructed. The flood protection system Srednje Posavlje, with a total surface of about 304,000 ha and the planned retention capacity of more than 1,800 million m^3 and currently available capacity of about 1,200 million m^3, has an important role in flood protection for the section of the Sava River downstream from Stara Gradiška. Part of the protection system of Srednje Posavlje includes natural retentions of Lonjsko polje, Mokro polje, Odransko polje, Kupčina, Žutica, Zelenik, Trstik and Opeka, weirs Prevlaka, Palanjek and Trebež and three diversion channels: Sava-Odra, Lonja-Strug and Kupa-Kupa, and they have a positive effect on the flood regime in Croatia, but also in the countries downstream. Currently available capacities of the largest retention areas are: Lonjsko polje about 600, Mokro polje about 450, and Odransko polje about 300 million m^3.

On the right bank of River Sava in Bosnia and Herzegovina, in valleys of Posavina and Semberija, dykes represent the main flood protection structures, which most often provide protection from the high waters of 100-year return period (up to 1.2 m height). Dubica area along the mouth of River Una all the way to Orahovo is protected by dykes along the River Sava whose height is not sufficient to protect against Sava River high waters of 100-year return period. Dykes of variable height (0.6-1.2 m) in relation to high waters of 100-year return period are constructed along the mouth of River Vrbas in Srbačko-Nožičko area and Lijevče polje, but part of the dykes along River Vrbas are not of sufficient height on certain sections. Ivansko polje is protected from flooding by dykes along rivers Sava and Ukrina with the required protection elevation. In area of Odžak-Šamac at the mouth of River Bosna, dykes along the Sava River were built, as well as flood defence dykes along River Bosna, that do not satisfy the height requirements in regards to Sava River high waters of 100-year return period. Srednja Posavina area is protected from Šamac to Brčko by a dyke along the Sava River which at certain sections is of unsufficient height for high waters of 100-year return period. In the Semberija area to the mouth of River Drina, a defensive dyke was built along the Sava River with the required 1.2 m elevation on most of its length, while areas along the left bank of the mouth of Drina River are protected by a dyke of average height of 1.0 m over high waters of 100-year return period.

On the lower Sava River section in Serbia, dykes on both banks are not continuous. On the left bank, in the direction from Kupinovo to Sremska Mitrovica, natural floodplains are retained for retention and partial transformation of a flood wave. Dykes on the left bank mainly provide protection from the high waters of 100-years return period, with protection elevation of 1.2 meters. In this area is the natural reserve "Obedska Bara", which is a Ramsar site. With its flooding area of almost 12,000 ha and retention capacity of over 250 million m^3, it naturaly regulates Sava River high waters. When it comes to Belgrade, it can be concluded that quay walls and dykes in the central city zone do not provide adequate level of protection. On the right bank of Sava River at Obrenovac a dyke was built, which with dykes alongside Kolubara River protects Obrenovac and surrounding settlements

from the high waters of 100-years return period. On the section of Skela – Šabac, short dykes were constructed as protection of agricultural land and small settlements. Protection structures on section Šabac – confluence of Drina are 78% reconstructed, and there are ongoing works on reconstruction so by the end of 2019, 95% of the defence line will be functional and providing adequate level of protection. Numerous diversion channels and pumping stations are the weak links in the flood protection system.

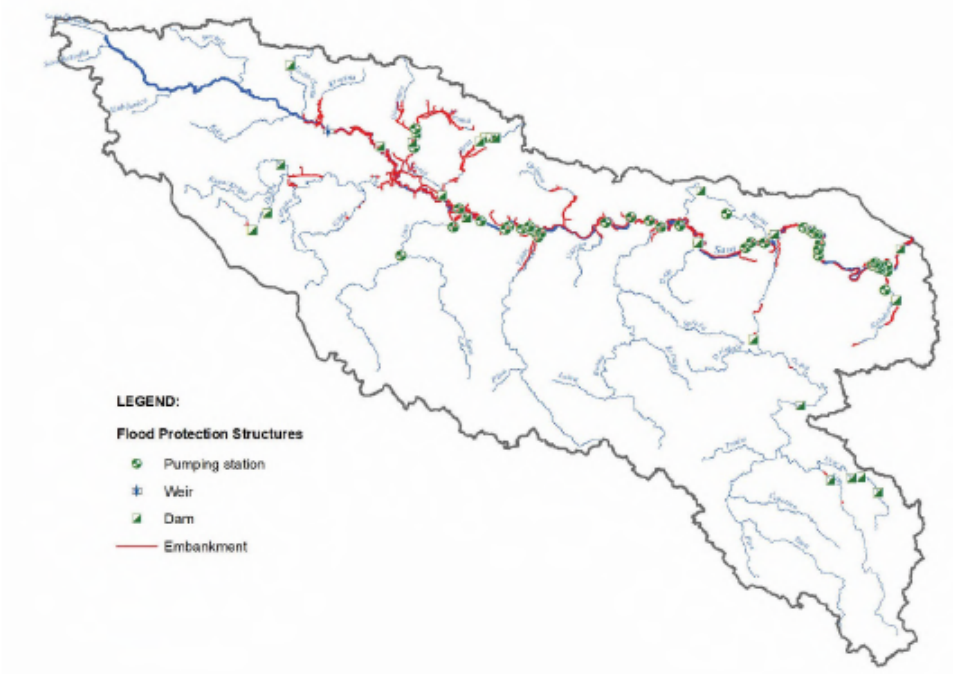


Figure 8: Flood protection structures along the Sava River and its tributaries (source: ISRBC, Sava GIS)

It is estimated that the Sotla / Sutla River is protected against the high waters of 10-years to 25-years return period. In the upstream part of the river there is a multipurpose reservoir of Vonarje / Sutlansko Lake. Flood protection of Karlovac and downstream part of the Kupa River is an integrated part of a comprehensive defence system against the floods of Srednje Posavlje. The remaining part of the Kupa River is mainly covered by regulationworks, protecting settlements and important roads. Generally, according to the current stage of the implemented river engineering works, it can be estimated that the Kupa River basin is protected against the high waters of 5-years to 50-years return period. In Bosnia and Herzegovina, flood areas along Una River are protected to the extent of areas under the influence of the Sava River. Many settlements on other tributaries remain unprotected. Flood defence structures along Drina River and its tributaries mainly protect larger settlements and industrial structures.

Agricultural land is protected only on downstream section of Drina in Mačva. Flood protection system includes reservoirs on rivers Drina, Piva, Lim, and Uvac. It is estimated that flood protection in the Bosut River basin correspondents to the high waters of 10-years to 100-years return period.

3.3.2 Dams and reservoirs

Large number of dams and reservoirs were constructed in the Sava River basin over the past period. The constructed reservoirs mainly have a multi-purpose character (water supply, irrigation, flood protection, hydropower and recreation).

According to the 2nd SRBA report, a total of 27 large dams and reservoirs (with volume greater than 5 milion m^3) of which 12 reservoirs were built that have a role in flood protection, among other purposes (overview of the main parameters is provided in Table 6). Most of these reservoirs are on the Sava River watercourse in Slovenia, while in other countries are built mostly on large tributaries.

The listed reservoirs have a certain role in flood protection, not only on rivers they are constructed on, but also on the entire downstream basin, although the effects on the flood wave transformation weaken downstream along the watercourse. Positive effect of the reservoirs on the flood waves transformations is conditioned upon their characteristics (position, volume, flood control zone, capacities of evacuation structures etc), as well as the manner in which they are managed, both just before and during floods.

Table 6: Overview of large dams and reservoirs important for flood protection in the Sava River basin

Country	Location		Dam		Reservoir	
	Basin	River	Name	Dam height (m)	Name	Volume (M m^3)
SI	Sava	Sava Dolinka	HPP Moste	59.60	Moste	6.24
		Sava	HPP Mavčiče	38.00	Trbojsko jezero	10.70
			HPP Medvode	30.00	Zbiljsko jezero	7.00
			HPP Vrhovo	24.00	Vrhovo	8.65
			HPP Boštanj	7.47	Boštanj	8.00
			HPP Arto-Blanca	9.29	Arto-Blanca	9.95
			HE Krško	9.14	Krško	6.31
SI,HR	Sotla/Sutla	Sutla	Vonarje	19.00	Sutlansko jezero	12.40
HR	Ilova	Pakra	Pakra	5.0-8.4	Pakra	12.00
BA	Sava	Spreča	Modrac	28.00	Modrac	88.00
RS	Drina	Drina	HE Bajina Bašta	90.00	Perućac	340.00
ME	Drina	Piva	HPP Piva	220.00	Mratinje	880.00
ME	Drina	Ćehotina	Otilovići	59.00	Otilovići	17.00

4 Conclusions of the Preliminary Flood Risk Assessment

Conclusions are derived based on the joint report on the Preliminary Flood Risk Assessment in the Sava River Basin, which was based on the national reports and areas with potentially significant flood risks (hereinafter: APSFR), and at the same time include an analysis of identified areas of mutual interest for flood protection in the Sava River basin.

4.1 PFRA – Preliminary Flood Risk Assessment in the Sava River basin

Based on the national preliminary flood risk assessments and identified APSFR, a joint report was drafted in 2014 pursuant to Article 6 of the Protocol – the *Preliminary Flood Risk Assessment in the Sava River Basin* (Sava PFRA). This assessment included Slovenia, Croatia, FBIH entity in Bosnia and Herzegovina, and Serbia, while for Republika Srpska[14], Brčko District BIH[15] and Montenegro[16], data was analysed during Sava FRMP preparation.

Table 7 lists the most important information related to PFRA in each country.

Table 7: Overview of PFRA information in the countries

Country		Defined methodology	Number of APSFRs in the Sava River Basin	Identified APSFRs	Types of considered floods	Considered effects of long-term development	Considered effects of climate change	International coordination
Slovenia		Yes	42	Yes	▪ fluvial ▪ pluvial ▪ ground waters ▪ marine waters ▪ artificial aquatic infrastructure	Yes	Yes	▪ all neighbouring countries ▪ ISRBC ▪ ICPDR ▪ ESPOO Convention
Croatia		Yes	1,688	Yes	▪ fluvial ▪ pluvial ▪ marine waters ▪ artificial aquatic infrastructure	No	No	▪ all neighbouring countries ▪ ISRBC ▪ ICPDR ▪ ESPOO Convention
Bosnia and Herzegovina	Federation of BIH	Yes	68	Yes	▪ fluvial	No	No	▪ ISRBC ▪ ICPDR
	Republika Srpska	Yes	87	Yes	▪ fluvial	Yes	No	
	Brčko District BIH	No	5	Yes	▪ fluvial	No	No	
Serbia		Yes	27	Yes	▪ fluvial	No	No	▪ ISRBC ▪ ICPDR
Montenegro*		Yes	9	Yes	▪ fluvial	Ne	No	▪ ISRBC

* Note: Identified during the project for the purpose of Sava FRMP preparation

[14] Preliminary Flood Risk Assessment for the territory of Republika Srpska, Public Institution "Vode Srpske" Bijeljina – Institute for Water Management Ltd. Bijeljina, 2014.

[15] Flood and landslide risk assessment for housing sector in Bosnia and Herzegovina, Institute for Hydrotechnology, Sarajevo, 2015.

[16] Municipal flood protection and rescue plans and Water Management Basis of Montenegro

4.1.1 Significant historic and potential future floods

Most significant flood events in the Sava River basin are listed in Table 8.

Table 8: Significant flood events in the Sava River basin

Year	Water course	Year	Water course
1896 October/November	Drina	1998 October/November	Upper Sava
1932 April	Sava	1998 November	Kupa
1933 October	Sava	1999 May	Tamnava, Ub and Gračica
1939	Kupa	2001 June	Kolubara, Jadar and Ljubovida r.
1944 November	Sava	2006 March	Tamnava, Ub and Gračica
1964 October	Sava	2006 April	Sava
1966 December	Sava, Kupa	2007 September	Upper Sava
1968 December	Bosna	2009 March	Tamnava, Ub and Gračica
1970 January	Sava and Bosut	2009 December	Upper Sava
1972	Kupa	2010 May/June	Middle Sava
1974 November	Sava, Krapina, Kupa and Una	2010 September	Middle Sava
1989 June	Krapina	2010 December	Drina, Kupa and Una
1990 October/November	Upper Sava	2014 February	Kupa
1996	Kupa	2014 May	Middle and Lower Sava, Una, Vrbas, Bosna, Drina, Bosut, Kolubara

Joint Sava PFRA report describes 22 historic flood events on the Sava River and its tributaries. Although the flood event from May 2014 was not included in the national reports prepared prior to that event, this flood was described in the Sava PFRA. The report stressed that the Sava River basin is prone to flooding, mainly in lowlands along the Sava River and on the confluence of larger tributaries into the Sava, but also in the upper parts of the basin where floods are characterised by certain torrential nature.

In Annex 7, Map 1 displays the spatial distribution of important historic flood events in the Sava River Basin.

The Sava PFRA describes potential harmful consequences of future floods to human health, environment, cultural heritage and economic activities in Slovenia, Croatia, Bosnia and Herzegovina – FBiH, and Serbia. In order to draw conclusions relevant for the entire basin, additional documents were analysed during Sava FRMP preparation for areas in Bosnia and Herzegovina (Republika Srpska and Brčko District BIH) and Montenegro.

4.1.2 APSFR – Areas of Potentially Significant Flood Risk

In order to develop Sava FRMP, countries had exchanged information about all areas of significant potential flood risk through the Sava GIS portal. Information from Slovenia, Croatia, Bosnia and Herzegovina and Serbia are official results of national PFRAs and identified APSFR, and data about proposed APSFR in Montenegro were defined based on information from the Water Management Basis of Montenegro and municipal flood protection and rescue plans. A total of 1,926 areas were analysed (Table 9).

Table 9: Overview of analysed APSFR from national documents (surface, population, and land use)

Country	Number of APSFR per national data	Total surface (km²) APSFR	Population* on all APSFR	Land use – surface (km²)** on all APSFR				
				Agricultural land	Forests and semi-natural areas	Artificial areas	Wetlands	Water surfaces
SI	42	81.79	251,566	27.68	10.85	40.65	0	2.61
HR	1,688	14,322.54	2,831,260	7,363.36	6,039.77	688.31	24.36	185.79
BA	160	1,595.32	1,188,797	1,290.28	128.47	102.86	2.04	71.68
RS***	27	2,812.10	82,156	1,862.44	697.07	186.36	16.28	49.95
ME****	9	40,62	65,355	23.12	9.74	7.47	0	0.28
UKUPNO	**1,926**	**18,852.37**	**4,419,134**	**10,566.88**	**6,885.90**	**1,025.65**	**42.68**	**310.31**

* GEOSTAT 2011 (EUROSTAT)
** CORINE (EEA, 2012)
*** PFRA areas
**** Proposal made during Sava FRMP preparation

Annex 7, Map 2, shows all APSFRs in the Sava River basin.

4.2 AMI – Areas of Mutual Interest for flood protection in the Sava River basin

Article 6 of the Protocol stipulates that based on the PFRA each Party shall, on parts of the River Sava within its territory, identify areas for which it concludes that potential significant flood risks exist, or can be considered to occur. The Sava Commission coordinates the activites on aligning identified areas shared by two or more Parties, which were defined by the Parties as areas of mutual interest for flood protection. Areas of Mutual Interest for flood protection in the Sava River basin (hereinafter: AMI) represent basic elements for analysis in the Sava FRMP. Additionally, the Program defined that Sava FRMP should also analyse all APSFRs on rivers with catchments exceeding 1,000 km², which was taken into account as a criterion when AMI areas were defined. Map 3 in Annex 7 shows the Areas of Mutual Interest.

AMI areas include a total of 251 flood areas (Table 5), respectively 129 APSFR areas in Croatia with a transboundary status, for which neighbouring countries confirmed were of mutual interest, 46 APSFR areas in BIH, 64 settlements which were not included in national APSFR areas in Slovenia, 7 areas in Serbia which included 27 APSFR areas (22 polylines and 5 points), and 5 flood areas in Montenegro identified as part of Sava FRMP preparation.

In total, by merging 251 flood areas, 21 AMI areas were identified:

- On Sava River, 4 AMIs were identified, as follows: 1 between Slovenia and Croatia; 1 between Croatia and Bosnia and Herzegovina; 1 between Croatia, Bosnia and Herzegovina, and Serbia; and 1 area entirely in Serbia;
- A total of 17 AMIs were identified on the following tributaries: Sutla, Bregana, Kupa, Una, Sana, Vrbas, Ukrina, Bosna, Tinja, Drina, Tara, Ćehotina, Lim, Bosut, and Kolubara.

Table 10 presents the overview of AMIs per river, number and share of potential flood areas within the AMI, as well as share of AMIs in the entire Sava River basin.

Table 10: Overview of AMIs

No.	AMI code	AMI surface	Number of potential flood areas	Country	Share of potential flood areas in the AMI		Share of AMI in the entire Sava River basin
		km²			km²	%	%
1	SI_HR_Sava	15.67	4	SI	8.,54	54.50	0.016
			1	HR	7.13	45.50	
2	HR_BA_Sava	1,643.42	43	HR	917.19	55.81	1.682
			24	BA	726.23	44.19	
3	HR_BA_RS_Sava	294.80	2	HR	31.38	10.65	0.302
			5	BA	166.09	56.34	
			1	RS	97.33	33.02	
4	RS_Sava	1,329.58	2	RS	1,329.58	100.00	1.361
5	HR_SI_Sutla_1	13.30	3	SI	7.71	57.94	0.014
			3	HR	5.59	42.06	
6	HR_SI_Sutla_2	15.31	3	SI	8.05	52.57	0.016
			3	HR	7.26	47.43	
7	HR_SI_Sutla_3	66.05	16	SI	37.34	56.54	0.068
			10	HR	28.71	43.46	
8	HR_SI_Bregana	4.86	1	SI	2.05	42.16	0.005
			1	HR	2.81	57.84	
9	HR_SI_Kupa_1	9.04	2	SI	4.77	52.73	0.009
			3	HR	4.27	47.27	
10	HR_SI_Kupa_2	37.82	9	SI	14.95	39.54	0.039
			5	HR	22.87	60.46	
11	HR_SI_Kupa_3	111.38	26	SI	44.72	40.15	0.114
			30	HR	66.66	59.85	
12	HR_BA_Una_Sana	218.30	20	HR	147.74	67.68	0.223
			10	BA	70.57	32.32	
13	HR_RS_Bosut	736.80	8	HR	355.30	48.22	0.754
			1	RS	381.50	51.78	
14	BA_Drina	6.02	2	BA	6.02	100.00	0.006
15	BA_RS_Drina	954.67	4	BA	115.01	12.05	0.977
			1	RS	839.66	87.95	
16	ME_Cehotina	2.76	1	ME	2.76	100.00	0.003
17	ME_Lim	13.05	2	ME	13.05	100.00	0.013
18	ME_RS_Lim	10.19	1	RS	1.89	18.54	0.010
			1	ME	8.30	81.46	
19	RS_BA_Lim	17.79	1	BA	10.73	60.28	0.018

No.	AMI code	AMI surface	Number of potential flood areas	Country	Share of potential flood areas in the AMI		Share of AMI in the entire Sava River basin
		km²			km²	%	%
			1	RS	7.07	39.72	
20	ME_Tara	3.41	1	ME	3.41	100.00	0.003
21	RS_Kolubara	155.06	1	RS	155.06	100.00	0.159
	TOTAL	**5,659.29**	**251**		**5,659.29**		**5.79**

The largest area (1,643 km²) belongs to AMI in transboundary part of middle Sava (HR_BA_Sava), which includes 43 APSFRs in Croatia or 55.8% of total AMI size, and 24 APSFRs in Bosnia and Herzegovina or 44.2% of total AMI size. The share of this AMI in the entire Sava River basin is 1.7%.

The smallest surface (4.9 km²) belongs to AMI on transboundary part of Bregana River (HR_SI_Bregana), which includes 1 APSFR of 2.8 km² in Slovenia, and 1 APSFR of 2.1 km² in Croatia.

The largest AMI located in the territory of one country, but on a transboundary watercourse – Sava River is in Serbia (RS_Sava), and includes 1 APSFR covering a total of 1,330 km², which is 1.4% of the entire Sava River basin.

5 Flood Hazard and Risk Maps

Conclusions derived from available flood hazard and risk maps are based on the national elements of flood risk management planning. The countries delivered their available hazard and flood risk maps, and these are available on Sava GIS Geoportal.

In the Program, it was proposed that Parties should prepare flood hazard and risk maps at the Sava River basin level for all identified APSFRs, based on two scenarios:

- floods of medium probability for the 100 years return period (MP), and
- floods of low probability or extreme events, regardless of the return period considered by the country (LP).

For flood hazard maps, for each scenario the following should be shown: the flood extent, water depth and the flow velocity (where appropriate). Flood risk maps should show potential adverse consequences associated with flood scenarios expressed in terms of: the indicative number of inhabitants potentially affected, type of economic activity of the area potentially affected (based on Corine Land Use map), location of installations according to the EC Directive concerning integrated pollution prevention and control (IPPC)/Industrial Emissions Directive (IED) which might cause accidental pollution in case of flooding (based on the European Pollutant Release and Transfer Register, E-PRTR) and potentially affected protected areas identified in the Water Framework Directive and Natura 2000, national parks, as well as other relevant information (sediment transport). Before Sava FRMP preparation, flood hazard and risk maps had not been considered at the Sava River basin level.

In line with the Program, the proposal for elements of a joint methodology for preparation of flood maps for the whole Sava River basin was prepared, which is presented in Annex 3.

5.1 Conclusions derived from national flood hazard and risk maps

Countries in the Sava River basin are in different phases of flood hazard and risks maps development, and they used or have been using methodologies tailored to their national capacities and needs, which means that national results cannot be simply added to one another.

For the purpose of Sava FRMP, national flood hazard maps and risk maps for population, Corine database, and E-PRTR/IPPC register were used, to ensure consistency of data in the entire basin. Cultural heritage was not considered, because there was no available data on the level of the entire basin.

In Annex 5, Table 19 is given an overview of elements used in preparing flood hazard maps that the countries defined in their national methodologies, and in Table 20 is provided an overview of flood risk map contents defined in the national methodologies.

In **Slovenia**, an area of 220 km^2 is vulnerable on floods with low probability (1/500 years), while floods with medium probability (1/100 years) affect an area of 175 km^2, including parts of Ljubljana, Celje, and many other settlements. Number of temporary and permanent inhabitants on the vulnerable areas is about 84,000, with about 13,600 buildings, more than 900 units of cultural heritage and about 200 monuments of national importance, as

well as approx. 10,200 economic objects, 26 facilities according to IPPC Directive and SEVESO, and about 470 km of linear infrastructure.

Flood hazard and flood risk maps are publicly available on the Water Atlas web portal: https://gisportal.gov.si/portal/apps/webappviewer/index.html?id=11785b60acdf4f599157f33aac8556a6.

In **Croatia**, flood risk maps show the following: number of vulnerable population by settlements, data on economic activities according to Corine, information on infrastructure, environmental protection and cultural heritage. Flood extents defined on hazard maps shows potentially significant flood risks on about 20% (5,341 km²) of the land territory of Croatia in the Sava River basin, for floods with low probability, and 8.3 % (2,209 km²) of the territory for floods with medium probability. Approximate figures for categories under risk for floods with low probability include: 900 settlements with about 440,000 inhabitants, 800 important structures, 1,900 km of linear infrastructure, 29 IPPC/IED facilities, and 30 landfill sites. For floods with medium probability: 3 settlements with about 12,000 inhabitants, about 20 inhabited areas, 750 km of linear infrastructure, 2,500 km² of protected areas, 4 facilities, 9 landfill sites, as well as 1 UNESCO heritage site (for both scenarios).

Flood hazard and risk maps for Croatia are published on: http://korp.voda.hr.

Working versions of flood hazard and risk maps for certain rivers in **Federation of BIH** were prepared based on the methodology for preparation of flood risk and hazard maps from 2013 (only for the main rivers, 1st category). On the territory of Federation of BIH, vulnerable are 4,976 inhabitants and 2 facilities, which might cause accidentalpollution. For other vulnerable flood receptors, figures were not given. Hazard and risk maps were prepared for Vrbas River with tributaries in **Republika Srpska** and **Federation of BIH**, as well as River Pliva, and available are figures for return periods of 20, 100 (medium probability) and 500 years (low probability). In total, under threat of low probability floods is 90 km², out of which 85% in Republika Srpska and 15% in Federation of BIH. For medium probability floods, 65 km² are under threat, out of which 97% in Republika Srpska and 3% in Federation of BIH. On the flood risk maps, considered were categories of population, economy, protected areas, cultural heritage, and IPPC/IED facilities. For **Brčko District BIH**, hazard and risk maps were not prepared. Using the risk assessment for floods and landslides for the housing sector in BIH, the risk index for Brčko District BIH is 12/100, which puts it among areas with lower risk.

For Sava River basin in **Serbia** flood hazard maps were prepared for parts of the basin, including areas of Belgrade and Kolubara River sub-basin. Flood areas in case of extreme scenarios (1000-years return period) covers 470 km² of the territory of Belgrade. Vulnerable are settlements on the left bank (Belgrade's municipality of Surcin), and on the right bank the municipality of Obrenovac. In Belgrade, vulnerable are many residential and economic structures including facilities such as hospitals, kindergartens etc. Risk parameters are not numerically expressed. Risk maps for Kolubara show that an area of about 190 km² is vulnerable on floods with 100-years return period , while on floods with 1,000-years return period approx. 220 km² of protected and unprotected areas. Floods with low probability would affect wide valley area on downstream section in which is the settlement of Obrenovac and many smaller settlements, agricultural areas, powerplant TENT, industrial area in Barič, and farms as potential polluters. Surface coal mines are protected from floods with 1,000-years return period. Dykes situated upstream from the

surface mines don't provide sufficient protection, leading to potential vulnerability to parts of smaller settlements, agricultural areas, a magistral road and a railway. Kolubara River in Valjevo is partially regulated, and extreme flood scenarios would affect residential areas close to the river and an industrial zone.

In **Montenegro**, flood hazard and risk maps in the context of implementing the Floods Directive were not prepared. National protection and rescue plan and municipal flood protection and rescue plans include hazard and risk maps for historical large floods in certain municipalities for which the plans are prepared. In the Sava River basin protection and rescue plans are available for municipalities of Berane, Bjelo Polje, Mojkovac and Pljevlja. On River Lim, vulnerable are 1,200 inhabitants, 200 buildings, agricultural areas, one tourism object, and one private zoo. For infrastructure, magistral road Berane – Bijelo Polje, ringroad around Berane, and one bridge. On River Tara, about 260 inhabitants and 80 structures, as well as a magistral road and a railway. On Ćehotina river, vulnerable is agricultural land and magistral road Pljevlja – Gradac.

5.2 Overview of flood risks for Areas of Mutual Interest based on available national flood maps

Based on available national data in Sava GIS, as a special annex to Sava FRMP an Atlas of flood hazard and risk maps for Areas of Mutual Interest was prepared. Flood extents defined by the countries as potentially being vulnerable from floods were used for presenting in which areas within AMIs flood hazards are present (or not) for the two scenarios. For the hazard areas, risks were determined for the potential consequences on inhabitants[17], economic activities[18], and environment.

Flood risk analysis was done for all 21 AMI areas using raster of 100 x 100 m cell size. Numerical data related to hazard and risk areas in AMIs is presented in Table 11.

[17] Population density (source: Geostat 2011 – EUROSTAT) from 1 km x 1 km grid, discretized on 100 m x 100 m raster
[18] Land cover (Corine 2012)

Table 11: AMIs figures[19]

AMI	Area	Flood hazard area		Indicative number of inhabitants potentially affected		Potentially affected area for economic activities		Potentially affected protected areas (WFD)	
		km²				km²		km²	
	km²	MP	LP	MP	LP	MP	LP	MP	LP
SI_HR_Sava	15.67	10.80	11.07	5,757	5,757	9.72	9.99	0.83	0.84
HR_BA_Sava	1,643.42	287.19	927.65	145,504	197,998	86.19	527.22	209.75	471.35
HR_BA_RS_Sava	294.80	7.43	30.83	1,474	2,304	0.08	18.41	3.41	3.48
RS_Sava	1,329.58	90.47	266.47	151,975	401,206	62.71	193.72	3.93	4.35
HR_SI_Sutla_1	13.30	3.68	4.11	7,279	7,279	3.50	3.89	1.00	1.07
HR_SI_Sutla_2	15.31	2.13	2.58	1,348	1,493	2.08	2.50	0.98	1.04
HR_SI_Sutla_3	66.05	2.28	3.06	8,217	16,421	1.95	2.53	1.77	2.19
HR_SI_Bregana	4.86	0.49	0.61	2,378	2,378	0.26	0.32	0.04	0.04
HR_SI_Kupa_1	9.04	0.30	0.35	313	313	0.09	0.12	0.29	0.33
HR_SI_Kupa_2	37.82	0.53	0.57	262	262	0.09	0.10	0.53	0.57
HR_SI_Kupa_3	111.38	2.98	3.42	2,776	2,776	1.78	1.95	2.98	3.42
HR_BA_Una_Sana	218.30	29.04	40.60	26,967	27,622	16.66	25.07	26.78	37.85
HR_RS_Bosut	736.81	126.10	318.64	2,118	8,141	17.15	155.69	108.28	153.19
BA_Drina	6.02	2.17	2.41	65,207	65,207	1.21	1.34	-**	-**
BA_RS_Drina	954.67	-*	-*	-**	-**	-**	-**	-**	-**
ME_Cehotina	2.76	1.35	1.49	3,978	3,978	0.72	0.80	0.020	0.04
ME_Lim	13.05	11.07	11.97	21,450	21,741	4.79	5.21	0.13	0.13
ME_RS_Lim	10.19	8.01	8.70	23,771	23,771	5.55	5.87	-**	-**
RS_BA_Lim	17.79	-*	-*	-**	-**	-**	-**	-**	-**
ME_Tara	3.41	2.89	2.98	3,358	5,743	0.91	0.94	0.10	0.10
RS_Kolubara	155.06	84.47	105.43	44,884	55,536	74.11	91.28	0.20	0.20

* hazard area not identified
** data for risk on receptors not available

[19] Numerical data relates to multiple AMIs whose surface includes RS. AMI areas in RS did not encompass all APSFR areas, and for this reason the data might differ from those extracted from national flood hazard and risk maps

In the largest AMI, HR_BA_Sava, the area exposed to flood hazard for medium probability scenario is about 300 km², and for low probability scenario about 900 km². In that area, almost 150,000 inhabitants are potentially affected (1.8% of total population in the Sava River basin) for medium probability scenario, and 200,000 inhabitants (2.5% of total population in the Sava River basin) for low probability scenario. The area under flood risk is about 90 km² for medium probability scenario, and about 500 km² for low probability scenario. The protected areas (WFD) potentially affected amount to about 200 km² and about 500 km² for medium and low probability scenarios, respectively.

6 Objectives of the flood risk management of mutual interest on the Sava River basin level

Objectives of the flood risk management of mutual interest on the Sava River basin level are based on the Program, objectives defined in national FRM plans and documents, Flood Risk Management Plan for the Danube River Basin, as well as taking into account other documents of the Sava Commission and member countries.

Objectives of the flood risk management of mutual interest in the Sava River basin are:

1. Avoidance of new flood risks;
2. Reduction of existing flood risks (during and after the floods);
3. Strengthening resilience;
4. Raising awareness about flood risks;
5. Implementing solidarity principle.

Avoidance of new flood risks

By creating a balance between the development and use of space in areas with the highest flood risk, and cooperation of competent spatial planning institutions and flood risk management institutions, it is possible to avoid new risks or to reduce them to an acceptable level. Flood risks and potential risks should be identified and considered at the earliest phase of the planning process.

The May 2014 floods showed the need to adjust the existing flood protection programs, as well as planned and ongoing projects for improving flood protection levels.

Construction in areas with high flood risks should be prevented, especially in previously flooded zones, unless there are no adequate sites available in areas of lower risk, in accordance with the goals of planning and sustainable development. It is especially important to identify erosion prone areas including conditions for their use, and maintain existing forest areas in hill and mountain areas within the river basin. These measures could prevent erosion and landslides, which caused massive damage in 2014 floods.

It is important for all the countries to prepare flood hazard and risk maps, and to include these results into spatial plans of lower administrative levels. Competent authorities should use special conditions and permits to limit construction in areas under flood hazards and lower the flood risk in potential flood areas. In cases where construction cannot be avoided, the risks should be lowered to an acceptable level.

Reduction of existing flood risks

Reducing the existing risk of floods is achieved by applying structural measures that stop or restrict the spread of floods (maintenance and improvement of flood protection systems), and non-structural measures aimed at reducing vulnerability and exposure of people and communities, property, economic activity, environment and cultural heritage to consequences of floods.

Significant impact on the reduction of existing flood risks in the part related to the reduction of flood exposure is achieved by applying measures that foresee harmonisation of flood risk management measures with spatial planning documentation.

Continuing activities to strengthen capacity and implement preventive preparatory actions, immediate flood protection measures and action after the end of regular flood defence in the countries will certainly help reduce the existing flood risks. The measures recognised and taken by the countries on the basis of national obligations, as well as those defined as mutual, should contribute to reducing the existing flood risks in the Sava River basin. Maintenance of flood protection structures should be planned and available on long-term basis. Procedures for approvals related to planning and construction of flood protection structures should be simplified and made quicker. Attention should also be paid to implement these procedures in line with the best European practices, especially having in mind requirements of the Water Framework Directive, as well as other water-related directives.

Safety and operational readiness of systems depends on employees with relevant local and technical knowledge, and therefore staff of the state water management agencies should be additionally trained having in mind all the previous flood experiences.

Sustainable management of deposits to maintain the water regime can also contribute to reducing the flood risks.

It should be noted that the Protocol in Article 11 emphasises that Parties are obliged to take appropriate measures to establish and maintain preparedness, as well as measures related to the emergency flood defence. The Parties shall ensure that such measures include those to mitigate transbundary impacts.

Strengthening resilience

Strengthening resilience to floods is a multi-sectoral process which includes numerous participants, and needs to be undertaken based on their cooperation and coordination. Implementation of solutions for strengthening the resilience in the Sava River basin that are of international significance, should be coordinated by the countries, bilaterally or through ISRBC, and be technically rational, effective, and feasible.

The 2014 flood showed the need for a hydrological study for the Sava River basin based on agreed joint methodology, which would analyse meteorological and hydrological elements important for integrated water and flood risk management in the Sava River basin.

In each country efforts should be made to improve the infrastructure for meteorological and hydrological monitoring, including capacity building in competent institutions. Improvements of forecasting and warning systems require qualified staff, training, and constant exchange of experiences.

The Sava Commission has already taken specific steps and has established common forecasting, warning and alert systems in the event of flooding in the Sava River basin.

Raising awareness about flood risks

Understanding the exposure and vulnerability to flood risk is a key step in preparing and building resilience. Effective solutions for strengthening resilience to floods will need the improvement of stakeholder capacities and increased public understanding in order to be faster and more flexible when disaster occurs. The Sava countries recognized the importance of information exchange in the event of floods, especially those with transboundary impact, and to ensure effective information of professional and general public have established the Sava Geoportal as an information and communication platform.

Sava GIS should continue to be improved in order to serve as an information source on implementation of measures, and for further public awareness raising about flood risks.

Special attention should be given to improving public awareness and quick reaction capacities in case of sudden floods and torrents. Community awareness about flood risks should be improved ad maintained, with clear understanding of their role in proper response to emergency situations. Community activities are very important in coordinated evacuation from the affected area, maintaining health and hygienic conditions in flooded areas, as well as to prevent accidental pollution. Organised media communication is also of key importance.

Implementing the solidarity principle

Taking into account the principle of solidarity and the no-harm principle in accordance with Article 9 of the Framework Agreement, the Sava FRMP foresees measures which, by their scope or impact, must not or will not significantly increase risks of flooding in the territory of another Party.

To implement the solidarity principle in the event of an emergency flood defence, the affected Party or Parties may seek assistance from other Parties, stating the extent and type of assistance they need. Parties from which the assistance is sought are required to consider such a request in the shortest possible time, and the requesting Party should be informed of the possibilities for providing the requested assistance, as well as its scope and conditions.

7 Catalogue and Summary of Measures

Non-structural measures on the basin level and national structural measures in areas of mutual interest (hereinafter: measures) were identified with the emphasis on reducing potential adverse consequences on human health, the environment, cultural heritage, and economic activity, as well as reduction of flood occurrence.

In the previous period, countries in the Sava River basin regularly exchanged information on flood protection measures during the preparation and implementation of the aforementioned planning documents and events:

- In the Action Plan for flood protection at the sub-basin level – Sava River basin (ICPDR in cooperation with ISRBC, 2009), countries in the Sava River basin defined common objectives and proposed measures in their territories divided into 4 groups:
  1. Regulation of land use and spatial planning;
  2. Reactivation of former or creation of new retention and detention capacities;
  3. Structural flood defence measures;
  4. Non-structural measures (preventive actions, capacity building of professionals, raising awareness and preparedness of general public).
- In the *Flood Risk Management Plan for the Danube River Basin*[20] (ICPDR, 2015), countries in the Sava River Basin also defined measures which contribute to achieving objectives of flood risk management in the Danube River basin. The measures were classified according to aspects of flood protection and groups of measures defined by the European Commission;
- Workshop on Flood Risk Management measures and links with the EU WFD, organised in November 2015 by the Sava Commission in cooperation with the UNESCO Regional Office for Europe, WMO and ICPDR, proposed drafting of a catalogue of measures with the goal of improving understanding of potential measures' scope and terminology within the process of preparing flood risk management plans.

For the purpose of the Sava FRMP, measures were taken from the adopted national flood risk management plans of Slovenia and Croatia, draft flood risk management plan of Serbia, and strategic and planning documents of Bosnia and Herzegovina and Montenegro.

7.1 Catalogue of Measures

The catalogue of measures is a set of consolidated non-structural and structural measure types from all phases of flood risk management cycle, tailored to countries' needs.

According to guidelines of the European Commission[21], the proposed common measures are classified into 17 groups within 5 aspects: flood prevention (measures M21-M24), flood

[20] www.icpdr.org/flowpaper/viewer/default/files/nodes/documents/1stdfrmp-annex2-5.pdf.

[21] http://cdr.eionet.europa.eu/help/Floods/Floods_603_2016/resources/User%20Guide%20to%20the%20Floods%20schema%20v6.0.pdf

protection (M31-M35), preparedness (M41-M44), restoration and review (M51-M52) and other (M61).

Table 12: Types of measures

Aspect of flood risk management	Type	Measure Group	Description
No Action	M11	No Action	No measures are proposed to reduce the flood risk in the APSFR or other defined area
Prevention	M21	Avoidance	Measure to prevent the location of new or additional receptors in flood prone areas (land use planning policies or regulation)
	M22	Removal or re-location	Measure to remove receptors from flood prone areas, or to relocate receptors to areas of lower probability of flooding and/or of lower hazard
	M23	Reduction	Measure to adapt receptors to reduce the adverse consequences in the event of a flood actions on buildings, public networks, etc.
	M24	Other prevention measures	Other measures to enhance flood risk prevention, (may include flood risk modelling and assessment, flood vulnerability assessment, maintenance programmes or policies, etc.)
Protection	M31	Natural flood management / runoff and catchment management	Measures to reduce the low into natural or artificial drainage systems, such as overland flow interceptors and / or storage, enhancement of infiltration, etc and including in-channel , floodplain works and the reforestation of banks, that restore natural systems to help slow flow and store water, extension of floodplains within historical morphological alluvial areas, increase of retention capacities of existing floodplains, establishment of temporary retentions etc; improving methods for ecologically acceptable approach to flood risk reduction
	M32	Water flow regulation	Measures involving physical interventions to regulate flows, such as the construction, modification or removal of water retaining structures (e.g., dams or other on-line storage areas or development of existing flow regulation rules), and which have a significant impact on the hydrological regime
	M33	Channel, riverbanks and floodplain works	Measures involving physical interventions in freshwater channels, mountain streams and flood-prone areas, such as the construction, modification or removal of structures or the alteration of channels, sediment dynamics management, dykes, etc.
	M34	Surface water management	Measures involving physical interventions to reduce surface water flooding, typically, but not exclusively, in an urban environment, such as enhancing artificial drainage capacities or though sustainable drainage systems
	M35	Other protection measures	Other measure to enhance protection against flooding, which may include flood defence asset maintenance programmes or policies
Preparedness	M41	Flood forecasting and warning	Measures for establish or enhance a flood forecasting or warning system
	M42	Emergency event response planning / Contingency planning	Planning activities in case of emergency situations, measures to establish or enhance flood event institutional emergency response planning

Aspect of flood risk management	Type	Measure Group	Description
	M43	Public awareness and preparedness	Measure to establish or enhance public awareness or preparedness for flood events
	M44	Other measures for preparedness	Other measures to establish or enhance preparedness for flood events to reduce adverse consequences
Recovery and review	M51	Individual and societal recovery	Clean-up and restoration activities (buildings, infrastructure, etc); Health and mental health supporting actions, incl. managing stress; Disaster financial assistance (grants, tax), incl. disaster legal assistance, disaster unemployment assistance; Temporary or permanent relocation; Other
	M52	Environmental recovery	Clean-up and restoration activities (with several sub-topics as mould protection; well-water safety and securing the disposal sites/landfills for hazardous materials); re-naturalization and revitalization of natural (flood) habitats – zones; Other
	M53	Other recovery measures	Other elements of recovery and review; Lessons learnt from flood events; Insurance policies; Other
Other	M61	Other	Other

7.2 Summary of Measures

Bearing in mind examples of good practice and successful regional cooperation on completed or ongoing projects (1st Sava RBMP, 2nd SRBA, Sava GIS, Sava HIS, Hydrological model for the entire Sava River basin, Hydraulic model for the Sava River including accurate digital elevation model of the Sava main watercourse, Sava Flood Forecasting and Warning System, Sava PFRA and other), as well as taking into account the needs of non-EU member states in the Sava River basin (Bosnia and Herzegovina, Montenegro and Serbia) in launching projects contributing to the achievement of national and common priority flood risk management objectives and the support of the Sava Commission in finding the financial resources to initiate these projects, expert and technical assistance of the Sava Commission to all the countries in the basin during the project implementation and monitoring of their effects, the following measures have been identified:

- 42 non-structural measures divided into 11 groups of measures, out of which 3 belong to prevention measure M23, and 12 to M24; protection measures include 5 of the M31 and 6 measures of M35; preparedness measures include 9 measures of M41, 3 of M43 and 3 of M44; 1 measure belongs to M53 - recovery and review;
- 38 national structural measures in areas of mutual interest, 4 of which belong to protection measure M32 (water flow regulation), while 34 belong to protection measure M33 (channel, riverbank and floodplain works).

In the Sava Commission's report on 2014 floods[22], a group of measures which include all five aspects of flood risk management for international and national rivers was recommended. Non-structural measures included spatial planning and land use determination having in mind that very serious damages to residential objects and infrastructure were caused by inappropriate (and often illegal) use of land near rivers which can have very high flows during floods, and in flood-prone areas themselves. It is needed to not only limit further development in flood-prone areas, but also use special conditions and permits to limit any further increase of flood risk in potentially flood risk areas.

It's important to designate erosion-prone areas, and recommend conditions for their use, to sustain existing forests and afforest hilly and mountain regions, and propose construction of facilities only in areas not affected by floods.

The need to align existing protection programs to an adequate flood risk protection level was also noted. In the Sava River basin countries, flood protection structures were designed and built based on criteria which were set more than 40 years ago. However, there are still areas under potential flood risk along River Sava not protected from high waters, especially in settlements. Therefore, measures for sustainable protection should be undertaken along the entire basin to increase it to the required level, while respecting environmental, economic, social and other aspects, in order to reduce the possibility of catastrophic consequences such as during the 2014 flood.

Maintenance and development of capacities for retention of floods is significant not only for the main Sava watercourse, but also for its tributaries, especially those with transboundary or downstream impact. In the Sava River basin are large dams and reservoirs with downstream impacts that can cause material, human, and ecological catastrophes. This requires a timely analysis of their transboundary impacts, improvements of the flood retention capacities, and better coordination among the Sava countries in solving mutualissues. Measures for sediment discharge are also important for preventing and protection from flood risks.

Special emphasis is given to measures aimed for regular maintenance of flood protection structures, especially having in mind that in some countries such maintenance has been lacking for years due to lack of financies. By regular monitoring of conditions of flood protection facilities and their maintenance, the designed function can be realised and ensured reliability. Within maintenance measures, examples of good practices should be used, for example by aligning annual maintenance plans with institutions responsible for environmental protection issues.

The proposed non-structural and national structural measures in areas of mutual interest were analysed taking into account the following aspects:

- Available technical and other information on projects;
- Effects of areas (retentions) with natural and regulated flood retention;
- Transboundary impacts;
- Information from Sava RBMP;

[22] http://www.savacommission.org/dms/docs/dokumenti/documents_publications/publications/other_publications/sava_floods_report.pdf

- Environmental objectives of the Water Framework Directive;
- Climate change impacts.

A proposal for elements of a simplified methodology for costs-benefit assessment of the measures implementation (Annex 4) was also prepared, which the countries can use for projects for which a more detailed cost-benefit analysis (hereinafter: CBA) hasn't been performed yet.

7.2.1 Non-structural measures

Overview of non-structural measures is provided in Annex 6, Table 21. Indicative priorities have been determined through an expert judgement according to the following criteria: importance of the flood risk management measure for the Sava River basin, information included in the national flood hazard and risk maps, status of the water body, potential for increasing retention capacities, environmental impacts, and possibilities of financing.

Measures of high indicative priority include:

- Measures that are of mutual interest for implementation of activities on the national and the Sava River basin level, pertaining to the provision of data and components for the preparation of the next Flood Risk Management Plan in the Sava River Basin;
- Measures that support improvements of realtime data collection systems and provide basis for hydrological forecasting.

7.2.2 Structural measures in areas of mutual interest

The following documents and information were used for proposing the national structural measures:

- national flood risk management plans for Slovenia and Croatia;
- draft flood risk management plan for Serbia;
- water management strategies;
- information on the flood related projects and activities regularly exchanged through the Sava Commission;
- additional information based on proposals of countries.

Overview of national structural measures in Areas of Mutual Interest is provided in Annex 6, Table 22.

7.2.3 Spatial distribution of measures

Figure 9 shows spatial distribution of structural measures in Areas of Mutual Interest.

Figure 9: Spatial distribution of structural measures in Areas of Mutual Interest (sources: 2nd SRBA and Sava FRMP)

There are 7 structural measures identified in the largest AMI HR_BA_Sava. The next AMI according to the size is RS_Sava with 9 measures on the Sava River, followed by RS_Kolubara with 5 measures on Kolubara River and BA_RS_Drina with 3 identified structural measures on the Drina River.

Taking into account past flood events, area size and number of potentially affected inhabitants in AMIs, the spatial distribution and number of proposed measures corresponds to potential flood hazards and risks areas.

Non-structural measures mostly relate to entire AMIs or the Sava River basin as a whole.

7.2.4 Water retention measures

Water retention is an active flood risk management measure, by which part of the flood wave is released to natural or regulated area in a controlled manner, with a positive impact on reducing the flood wave peak downstream from the retention. Aside from the flood water regime impact and reduction of the flood risk, retentions and their use during flood events can have a whole range of effects on various natural and social factors, including economic activity, environment, biodiversity, and other.

Impact of water retention measures has been determined based on the description related to a certain measure type.

Proposed are 4 structural measures shown in Table 13.

Table 13: Water retention measures

AMI	River	Measure
RS_Sava	Sava	Protection of the City of Belgrade: Regulation of Topčiderska reka basin – regulation of Topčiderska reka with construction of small dams, reservoirs and retentions in the basin
HR_SI_Kupa	Kupa	Flood protection of Čabar town. Reservoir of dual purpose is envisaged – (1) deposit retention (2) sport-recreational area
HR_SI_Sutla_3	Sutla	Flood protection Vonarje – modernization and upgrade of Vonarje dam (Frisco 2.1)
RS_Kolubara	Kolubara	Regulation of Kolubara basin – construction of 20 small retention dams in the basin

Sava FRMP also includes 5 nonstructural measures of type M31.

7.2.5 Transboundary impact of measures

Coordination in determining the measures, defined based on different water policies of the countries, and aimed at information and data exchange on measures with a transboundary impact, and proposals for acceptable measures in Areas of Mutual Interest for flood protection in the Sava River basin, is undertaken through activities of the countries within the Sava Commission and the preparation of Sava FRMP. Common understanding of the objectives of flood risk management of mutual interest in the Sava River basin, and the identification of mutual benefits for the Sava River countries represent the basis for compilation of measures that may not, by their magnitude or impact, significantly increase the flood risk on the territory of the other country, unless those measures are coordinated and agreed between the countries concerned.

For these reasons, and to be able to coordinate the process of identifying the measures, AMI areas were defined along the following transboundary rivers: Sava, Sutla, Bregana, Kupa, Una, Drina, Tara, Ćehotina, Lim, and Bosut. If a measure belongs to an AMI that includes a transboundary river, it is assumed that such measure has a transboundary impact.

Structural measures in AMI areas on national rivers (Sana, Vrbas, Ukrina, Bosna, Tinja, and Kolubara) don't have a direct transboundary impact, but are considered to be of a significant importance for the Sava River basin.

As a non-structural measure of type M34, an analysis is proposed to assess transboundary impacts of significant flood protection structures. An example would be the Srednje Posavlje system, which has not only a key importance for Sava River flood protection in Croatia, but also a positive effect on neighbouring countries of Bosnia and Herzegovina, and Serbia.

7.2.6 Integration of flood risk management in water protection activities at the Sava River basin level

This chapter contains preliminary assessment of the proposed structural measures from the aspect of their potential synergies with environmental goals set forth in the Water Framework Directive (hereinafter: WFD), i.e. measures defined in the Sava River Basin

Management Plan (RBMP, 2014). The reason for setting coordination of measures from both plans (i.e. objectives from FD and WFD Directives), follows the requirement for development of the Common Implementation Strategy (CIS) of the Water Framework Directive. The resource document - Links between the FD and WFD[23] provides recommendations and guidelines for achieving potential synergy and coordination of Directives.

Measures from the Water Framework Directive include those that enable the hydromorphological characteristics of water bodies for achieving the required ecological status or good ecological potential. The WFD requires implementation of measures to mitigate hydromorphological impact on water bodies due to existing or proposed modifications. Existing hydromorphological modifications as results of flood protection structures for mitigation of flooding have led to significant modifications in water bodies. These water bodies have to achieve good ecological potential.

Based on spatial data related to the risk assessment of 2nd SRBA, the current hydro morphological alterations originating from the past and the pressures that may occur in the future in the AMIs were taken into account. The 2nd Sava River Basin Analysis showed that there were 16 water bodies (71%, or 919 km) on the Sava River that are at risk of failing to achieve good status due to hydromorphological alterations. The risk is unknown for three water bodies (18%), while 9 water bodies (only 11% of the total river length) are not at risk. Risk assessment on the Sava River tributaries demonstrated that 24% water bodies are at risk (1,164 km), 61% water bodies are not under risk, while there is no data on hydromorphological alterations for 14% water bodies. Seven heavily modified surface water bodies have been identified on the Sava River, and they are all used for flood protection.

Overview of the water bodies' status in AMI areas is shown in Table 14.

Table 14: Overview of the status of water bodies in AMIs

	AMI	River	Water body		
			Natural	Candidate for significantly modified	Significantly modified / artificial
1	HR_SI_Sutla_1	Sutla	SI, HR	-	-
2	HR_SI_Sutla_2	Sutla	SI, HR	-	-
3	HR_SI_Sutla_3	Sutla	SI, section in HR	HR	-
4	HR_SI_Bregana	Bregana	SI, HR	-	-
5	SI_HR_Sava	Sava	SI, HR	-	-
6	HR_BA_Sava	Sava	HR, BA	HR, BA	-
7	HR_BA_RS_Sava	Sava	-	HR, BA, RS	-
8	HR_RS_Bosut	Bosut	HR	RS	-
9	HR_SI_Kupa_1	Kupa	SI, HR	-	-
10	HR_SI_Kupa_2	Kupa	SI, HR	-	-

[23] CIS resource document: Links between the Floods Directive (FD 2007/60/EC) and Water Framework Directive (WFD 2000/60/EC), Technical Report – EU, 2014

	AMI	River	Water body		
			Natural	Candidate for significantly modified	Significantly modified / artificial
11	HR_SI_Kupa_3	Kupa	SI, HR	-	-
12	HR_BA_Una_Sana	Una	HR, BA	-	-
13	BA_Drina	Drina	-	BA	BA
14	BA_RS_Drina	Drina	-		BA, RS
15	ME_Cehotina	Ćehotina	ME		ME
16	ME_Lim	Lim	ME		
17	ME_RS_Lim	Lim	ME, RS	-	-
18	RS_BA_Lim	Lim	RS	BA	RS
19	ME_Tara	Tara	ME		
20	RS_Sava	Sava			RS
21	RS_Kolubara	Kolubara	RS	RS	RS

Therefore, analysis was conducted to identify the aspects in which each individual structural measure contributes to the achievement of the WFD objectives, i.e. group of measures proposed in the RBMP, and related to:

- organic pollution;
- nutrient pollution;
- hazardous substances pollution;
- hydromorphological alterations (interruption of rivers and habitat continuity, hydrological alterations, morphological alterations);
- groundwater quality;
- groundwater quantity;
- invasive alien species;
- quantity and quality aspects of sediment;
- protected areas and ecosystem services.

The assessment resulted in categorisation of structural measures into three categories:

- measure supports the achievement of environmental objectives of the WFD, and measures planned in RBMP;
- measure has no influence on the achievement of environmental objectives of the WFD, and measures planned in RBMP;
- measure is potentially in conflict with the environmental objectives of the WFD, and measures planned in RBMP.

Based on a preliminary analysis of the planned structural measures, it was estimated that 3 measures (including 6 project interventions) support the achievement of environmental objectives of the WFD. These measures are related to regular maintenance and cleaning of the lateral channels along the Sava River, construction of drainage structures Bid – Bosutsko polje, and removal of structure (old bridge) near Hum on Sutla River, for which

was estimated to not only improve the flow, but also have long-term effects on the ecosystem protection and improvement of surface water quality.

There are two measures that were evaluated as neutral (without impact), and these concern pumping stations reconstruction.

Preliminary analysis of other identified measures has shown that they might potentially be in possible conflict with the environmental objectives of the WFD and the measures planned in RBMP. These are mainly traditional flood protection measures that change the hydrmorphological characteristics of water bodies in order to increase water flow, water retention, change of flows, reinforcement of river bank , construction and reconstruction of dykes, and similar.

During preparation and implementation of all the measures, it is necessary to perform a detailed WFD Compliance Assessment and to define measures to mitigate the impact on the ecological status/potential of water bodies. Depending on the degree of compliance of the national legislation with the EU regulations, this can be implemented as a separate process, or for example as part of the environmental impact assessment procedure.

It is important to understand that the range of measures presented in this Plan represents a wider approach to flood risk management, observing the water bodies and their ecosystems in a holistic way – as an integrated part of environment. With such wider approach, structural flood protection measures can also generate numerous positive effects in achieving good ecological status/potential of water bodies, which is the basic objective of the Water Framework Directive.

7.2.7 Conclusion of simplified analysis of potential environmental impact

Implementing the planned non-structural measures: preventive measures (best practices in construction, population self-protection, mapping, development of studies, databases, education), as well as different preparedness measures (improving the flood forecasting and warning system, improving preparedness of services and citizens, raising public awareness, information linking and exchange, etc.), will have indirect positive environmental impact and will positively affect social environment (public safety and health), while also improving adaptation to climate change.

Particular focus was put on analysis of national structural measures planned in areas of mutual interest, i.e. construction works planned by the countries in the forthcoming period. For each individual measure the following has been analysed: (1) the intensity of the potential adverse environmental impact, (2) the environmental vulnerability of the project implementation area, (3) possibility of transboundary impact, and (4) the proposal of basic measures to mitigate adverse impact. As a result of the analysis, preliminary assessment of the potential environmental impact of the measures was carried out (low / medium / high).

The main constraint during the analysis was the fact that projects are in different stages of development, some at the level of the proposal/concept, with insufficient information about the scope of the project and its components. In addition, during assessement of the environmental vulnerability, information about internationally protected Natura 2000 sites which were used are official in Slovenia and Croatia while in Serbia, Bosnia and Herzegovina and Montenegro are at the level of a proposal. It should also be emphasized

that the proposed measures have a wide range of coverage – from complex systems to smaller reconstructions.

Within this plan, 2 measures were considered to have potentially high environmental impact:

- construction of multipurpose reservoir in the Kupa River basin near Čabar (HR/SI);
- river flow regulation of the Tara River (ME).

Implementation of these projects may require larger land use, loss of fertile agricultural land, relocation of population, removal of roads, or adverse impact on protected habitats.

Environmental impact was rated as medium for 18 measures (that include 19 projects). These projects mainly relate to the construction of dykes on the Sava and riverbank protection structures in middle and lower Posavlje (HR), Mačva and Vojvodina (RS), construction of complex protective systems in Kolubara Basin (RS), regulation of torrential tributaries of Sutla (SI), and regulation of Ćehotina and Lim (ME). Impact of the remaining measures is low. These projects relate to reconstruction and extension of dykes, reconstruction of riverbank protection structures, cleaning of channels, etc. Although several of these measures are located in protected areas (e.g. Natura 2000 areas in Srednje Posavlje), they do not represent significant environmental risk due to technical type and limited scope, and procedures to mitigate their impact are well known and simply applicable through the best practices of management.

Although a lot of analysed projects are located at the transboundary rivers, the expected environmental impact of these projects is spatially limited to local level, without significant transboundary effects.

When planning future measures in the forthcoming planning period, it will be of great importance to preserve existing retentions and natural floodplains that represent great ecological value in the basin.

The national regulations require implementation of a detailed environmental impact assessment during the planning procedure and the permits obtaining for implementation of the planned measures. Given the possible financing of projects from the international financial institutions (WB, EBRD, EIB), it is recommended to timely initiate all required procedures, and to take into account the environmental and social issues as required by these institutions.

7.2.8 Climate change and planning the flood risk management at the Sava River basin level

The Floods Directive requires consideration and modification of approach in flood risk management, as such risks are increase due to climate change. Article 4 of the Directive requires, *inter alia*, that the probable impacts of climate change on the occurrence of floods should be taken into account during the preliminary flood risk assessment. Article 14.4 requires that probable impact of climate change on the occurrence of floods shall be taken into account in the reviews of theflood risk management plans.

In the the Common Implementation Strategy (CIS) for the Water Framework Directive, the guidance document: River Basin Management in a Changing Climate[24] it is stated there are likely to be challenges and limitations on the degree of consideration of climate change in undertaking the preliminary flood risk assessment, particularly in the first cycle. The main reason is given that the qualitative rather than quantitative information may be available or readily derivable. Experience from the EU member states indicates that this knowledge is foreseen to be improved in the second cycle, especially after the first flood hazard and risks maps and flood risk management plans.

Basic findings in addressing the effects of climate change (including their impact to flood risks) in the Sava River Basin, were set in the period 2010-2015 within implementation of the following projects:

- Pilot project on climate change: "Building the link between Flood Risk Management planning and climate change assessment in the Sava River Basin"[25] – UNECE, 2013;
- "Water and Climate Adaptation Plan for the Sava River Basin - WATCAP"[26] – World Bank, 2015.

The results of these projects show information obtained by using global and regional climate models that served to assess vulnerability to flooding in the Sava River Basin, taking into account parameters such as population, economic activity, infrastructure, facilities, protected areas and cultural heritage.

Based on the output of the hydrologic models developed within the WATCAP, conclusions about the future flood flows were as follows:

- An increase in average summer temperatures in the Sava River basin is exceeding global trends, while increased winter precipitation and decrease thereof in summer will lead to more frequent spring floods and more frequent summer droughts;
- The greatest increase of floods is expected in the head part of the Sava River Basin, i.e. in Slovenia (the Čatež hydrologic station) and in the main right tributaries (Kupa, Una and Bosna). By the end of 21st century, the 100-year floods along the Sava River will increase for more than 50% at Čatež, for about 15% between Zagreb and Slavonski Brod, for 25% at Županja, and for 9% at Sremska Mitrovica.
- The hydrologic projections indicate that the floods will increase in future due to climate change. The increase has been shown to be greater for 100-year floods than for the 20-year floods, thus suggesting an overall increase of the flood risk.

Most vulnerable areas in terms of flooding include capitals built along the Sava River (Ljubljana, Zagreb, Belgrade) and also to the smaller towns (Sisak, Slavonski Brod, Brčko, Karlovac), where urbanisation trend can be expected to continue in the future, due to a general migration of people from rural to urban areas. In addition, some parts between Zagreb and Slavonski Brod, as well as some eastern parts of the basin are vulnerable due to protected natural habitats. Moderate flood vulnerability is classified at almost 50% of

[24] https://circabc.europa.eu/sd/a/a88369ef-df4d-43b1-8c8c-306ac7c2d6e1/Guidance%20document%20n%2024%20-%20River%20Basin%20Management%20in%20a%20Changing%20Climate_FINAL.pdf

[25] Final project reports available at: http://www.savacommission.org/project_detail/17/1

[26] Final report available at: http://www.savacommission.org/project_detail/18/1

flood prone areas and the remainder is equally distributed between low and high vulnerability.

One of the results of the WATCAP was the Guidance note on adaptation to climate change for flooding, and measures proposed by this Plan (structural and non-structural ones) are in accordance with the guidance. A comparison of the adaptation measures proposed by the WATCAP project and the measures envisaged in this Plan is given in Table 15.

Table 15: Comparative overview of the recommended measures by the WATCAP and Sava FRMP

Measures on adaptation to climate change for flooding recommended by Water and Climate Adaptation Plan for the Sava River basin - WATCAP, 2015	Measures (structural and non-structural) planned in the Flood Risk Management Plan in the Sava River Basin
Development of a forecasting and early warning system (*improvement of monitoring network, modernisation of monitoring equipment, development of hydrological and hydraulic simulation models, institutional strengthening in forecasting and response in case of flood, improvement of operational cooperation in the FASRB countries*).	A set of non-structural measures M41 – *Flood forecasting and warning*, comprises measures for the establishment or improvement of flood forecasting and early warning system.
Development of strategic documents and policies, including those pertaining to flood risk management, spatial planning and implementation of the Flood Directive.	Within a set of non-structural measures M24 – *Other measures for improvement of prevention*, the Plan stipulates measures of which priority ones include development of flood hazard and flood risk maps, review and updating of preliminary flood risk assessment and joint platform SAVA GIS, preparation of common methodology for the development of flood hazard and flood risk maps, and so on.
Construction of new infrastructural facilities, as well as protection and improvement of the existing one aimed at adapting to climate change: (e.g. green infrastructure – use of natural floodplains and wetlands in order to integrate flood control and conservation of biodiversity, deepening and expanding the channel network, protection of urban areas, protection of roads, railways, industrial and healthcare facilities).	Within the proposed structural measures, the following project types have been recommended to increase adaptation capacity to climate change: - Retention / reservoir projects; - Projects for construction, reconstruction or superelevation of dykes (Sava, Una, Sana, Drina, Tara, Lim, etc.); - River flow regulation projects; - Projects for rehabilitation of riverbank protection structures; - Projects for cleaning and improving channel network; - Pump station reconstruction projects, etc.

In order to have a better overview of the effects of proposed measures in this Plan, their contribution to adaptation to climate change was analysed. All structural measures have been classified into 3 categories – high/medium/low importance for adaptation.

High importance measures are those which include construction of new flood protection systems while applying „green infrastructure" measures, as well as those significantly improving the protection of urban areas. These measures include Modernization and upgrade of Vonarje dam (Frisco 2.1), Flood protection of Čabar town, and as well as Protection of Kolubara River area – lower section of the river basin.

27 measures are considered to be of medium importance, and these are aimed at improving existing infrastructure for flood protection and resilience to new conditions (upgrading dykes, river flow regulation, and so on).

The remaining 8 measures of low importance are those related to regular maintenance or reconstruction of the existing protection structures.

In the forthcoming period, significant progress can be expected in the Sava River basin countries in adoption of strategies and plans for adaptation to climate change. Measures and results of these strategic documents will have to be considered within the next planning cycle.

7.2.9 Financing the measures

The following indicative sources for financing the measures were identified:

- The European Union funds (instruments/funds for the EU member states, and instrument for pre-accession assistance - IPA for candidate countries and potential candidates, including mechanisms for financial support in emergency situations and after major natural disasters);
- Public funds of the countries (state and local budgets, own revenues of institutions, including earmarked funds);
- International financial institutions (The World Bank, EIB, EBRD…);
- Bilateral donations and loans;
- Joint financial mechanisms and global funds (UN, Green Climate Fund-GCF...);
- Western Balkans Investment Framework (WBIF);
- Loans from commercial banks;
- Public-private partnerships (PPP).

Potential financial sources for non-structural measures are presented in Table 21 of Annex 6, while indicative sources for structural measures are provided in Table 22 of the same Annex.

8 Mechanisms of coordination on the Sava River basin level and modes of cooperation in the flood defence emergency situations

Implementation of the Framework Agreement provides for the cooperation of the Parties in achieving mutually agreed objectives for ensuring the integrity of the water regime, prevent or reduce transboundary impacts on neighbouring countries and coordinate activities on preparing and implementing Sava FRMP. Among other issues, the coordination includes: exchange of information and data on those areas for which potential significant flood risk exists or might be considered likely to occur, activities on identification of the areas of mutual interest for flood protection, information and data exchange about flood maps and activites on development of a joint methodology for preparation of flood maps at the basin level, defining objectives of flood risk management and measures for achieving them. The Sava Commission also monitors related activities on national and bilateral levels that can have an impact on joint activities at the basin level.

Pursuant to the Protocol, Parties undertake appropriate measures for establishment and maintenance of preparedness, as well as measures related flood defence emergency situations. Parties may request assistance from other Parties, indicating the scope and form of assistance needed.

Overview of existing mechanisms and actors in the flood management on national and international level is specified in Annex 2.

Elaboration of modes of mutual cooperation in flood emergency defence situations which included analysis of existing regulations, operational flood defence plans, bilateral agreements of neighbouring countries and reports, resulting in recommendations for improvement of cooperation.

In order to make the coordination of the Sava Commission and the roles of national institutions in the implementation of Sava FRMP fully clear and efficient, it is necessary to define procedures for modifying, harmonizing, coordinating, implementing and monitoring implementation activities of the Sava FRMP.

8.1 International multilateral coordination

8.1.1 Sava Commission

The Sava Commission is a joint body with the international legal authority for coordination of the implementation of the Framework Agreement and the Protocol. The Sava Commission is also a focal point in identification and coordination of regional projects important for implementation of the Framework Agreement, and a mechanism for strengthening mutual cooperation of Sava River basin countries in the water management. In addition to the PEG FP, expert groups participating in solving specific questions and tasks relevant for flood risk management are: Permanent Expert Group for River Basin Management (PEG RBM), Permanent Expert Group for GIS (PEG GIS), and Permanent Expert Group for Hydrological and Meteorological Issues (PEG HMI).

As a response to the most significant floods in Sava River basin, the Sava Commission coordinated a range of activities within its competence related to flood risk management, including initiation of emergency actions and recovery at relevant international institutions during and immediately after flood events, as well as preparation of reports on flood consequences with detailed information. It is also necessary to emphasize cooperation of the Sava Commission with the International Commission for the Protection of the Danube River, which includes joint elaborations and activities in areas of the water and flood risk management.

8.2 Competent authorities for flood management

Competence for water management activities in **Slovenia** belongs to the Ministry of Environment and Spatial Planning (*Ministarstvo za okolje in prostor*). Slovenian Environment Agency - ARSO is also a part of the Ministry, and its tasks include monitoring, analysing and forecasting natural phenomena and processes in the environment, reducing the natural threat to people and their property. Slovenian Water Agency, which is also a part of the Ministry, is the leading research and advisory organization in the area of integrated water management and common european water policy in the Republic of Slovenia. Slovenian Water Agency and its water management department drafts water and hydrological studies and legal regulations, including ground waters and groundwater protection, river regulation, protection against floods and erosions, solid waste management and wastewater treatment. The Inspectorate of the Republic of Slovenia is also responsible for enforcement of relevant laws.

In **Croatia**, the National Water Council is a Parliamentary body founded to consider systematic issues of water management, harmonize different needs and interests, and propose measures for development and improvement of the water system. The ministry responsible for all water management issues is the Ministry of Environment and Energy (*Ministarstvo okoliša i energetike*). Croatian Waters (*Hrvatske vode*) are a legal entity for water management (national agency), established for permanent and uninterrupted implementation of public services and other activities of water management within the framework of adopted plans. Organisational structure of Croatian Waters includes the Head Office (Directorate), water management departments, and water management branch offices.

In **Bosnia and Herzegovina**, the Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (*Ministarstvo vanjske trgovine i ekonomskih odnosa*) is responsible for carrying out tasks and activities related to definition of policies, fundamental principles, harmonisation of activities and plans of entity authorities and institutions at an international level in the field of agriculture, but also environment, development and use of natural resources. At the Federation of Bosnia and Herzegovina level, the Federal Ministry of Agriculture, Water Management and Forestry (*Federalno ministarstvo poljoprivrede, vodoprivrede i šumarstva*) carries out administrative, professional and other tasks stipulated by law pertaining to the competence of the Federation in the field of water management, while the Sava River Watershed Agency is tasked with water and flood risk management, in coordination with ministries of cantons. In Republika Srpska, the Government manages water resources through the Ministry of Agriculture, Forestry and Water Management (*Ministarstvo poljoprivrede, šumarstva i vodoprivrede*), as well as through Public Institution "Vode Srpske". Within the Brčko District BIH, the Department

for Agriculture, Forestry and Water Management (*Odjeljenje za poljoprivredu, šumarstvo i vodoprivredu*) conducts activities in the field of water management.

Water management within the territory of **Serbia** is within the competence of the Government, which carries out this activity through the Ministry of Agriculture, Forestry and Water Management (*Ministarstvo poljoprivrede, šumarstva i vodoprivrede*), other ministries, autonomous province authorities, local self-government units, as well as public water management companies. Water management is primarily under the competence of the Republic Water Directorate (*Republička direkcija za vode*), an administrative body within the Ministry. For Autonomous Province of Vojvodina, the water management competence belongs to the Provincial Secretariat for Agriculture, Water Management and Forestry. Activities of general public interest in area of water management on a certain territory are carried out by Public Water Management Companies (PWMCs). Competent PWMCs within the territory of Serbia are PWMC "Srbijavode" and PWMC "Vode Vojvodine".

Water management activities in **Montenegro** are primarily implemented by the Ministry of Agriculture and Rural Development (*Ministarstvo poljoprivrede i ruralnog razvoja*). The Ministry conducts activities related to development policies in water management and protection against harmful effects of water. The Water Administration (*Uprava za vode*) is the most important authority in this area. A significant part of competencies for water management was transferred to the local self-government units. This division was carried out according to the division of waters set forth in the Law, into waters of state importance and waters of local importance. Carrying out operational water related activities, as activities of general interest, was assigned by the Law to companies, other legal entities, public companies and entrepreneurs.

The list of competent government bodies and institutions in the Sava River basin responsible for protection against harmful effects of water is provided in Annex 1.

8.3 Mutual cooperation in flood defence emergency situations

Each of the countries has the primary responsibility for prevention and reduce of risk in flood defence emergency situations, also through international, regional, subregional, transboundary and bilateral cooperation. Flood risk reduction in emergency situations is the common objective of all countries, and the level to which the developing countries can effectively implement their national policies and measures in the context of their circumstances and capacities, can be additionally improved through sustainable international cooperation. Effective partnership and further strengthening of international cooperation, including fulfilling certain obligations of developed countries in providing assistance, are of key importance for the flood management in emergency situations .

Institutions responsible for operational flood defence are presented in Table 16.

Table 16: Overview of competent authorities for flood defence emergency situations in each country

Country	Institution	Description
Slovenia	- Ministry of Environment and Spatial Planning - Ministry of Defence - Administration of the Republic of Slovenia for Civil Protection and Disaster Relief – URSZR - Slovenian Environment Agency – ARSO - Slovenian Water Agency – DRSV	The system of protection against natural and other disasters is based on the obligation of the state and municipalities to prevent and eliminate hazards and to implement rapid measures in the event of a disaster. The system is also based on the obligation of companies, institutions and other organisations that, within their activities, are responsible for implementing urgent measures related to the protection and rescue of people and property, as well as the obligation of individuals to protect themselves and their property. The system is activated in case of accidents based on the hierarchy principle. The state and municipalities are responsible for organising protection against natural and other disasters as a unique and integrated national system.
Croatia	- Ministry of Environment and Energy - Hrvatske vode - Croatian Meteorological and Hydrological Service – DHMZ - National Protection and Rescue Directorate – DUZS	The Ministry for all matters of water management is the Ministry of Environment and Energy. Croatian Waters are responsible for operational flood defence. Croatian Meteorological and Hydrological Service is competent for monitoring and forecasting of meteorological and hydrological events. National Protection and Rescue Directorate is responsible for disaster management.
Bosnia and Herzegovina	- Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina - Ministry of Security – Operational Communication Centre - Federal Ministry of Agriculture, Water Management and Forestry - Sava River Watershed Agency - Adriatic Sea Watershed Agency - Federal Civil Protection Administration - Federal Hydrometeorological Service - Ministry of Agriculture, Water Management and Forestry of the Republika Srpska - Public Institution "Vode Srpske" - Republic Hydro-Meteorological Service of the Republika Srpska - Republic Administration of Civil Protection of the Republika Srpska - Department of Water Management of the Brčko District - Department of Public Safety of the Brčko District	Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina is competent to deal with issues of environmental protection and natural resources on state level. Ministry of Security is tasked to implement international obligations and cooperation in civil protection, coordination of entity services for civil protection and aligning their plans for natural and other disasters on the country level, and adoption of protection and rescue programs and plans. For managing protection and rescue actions in Federation of BIH, canton areas and municipalities, and for other activities in protection and rescue, civil protection centres are formed in line with the law and other regulations, as operational and expert bodies. The centres are established by the Federation, cantons, and municipalities. In Republika Srpska, the Ministry defines bodies responsible for flood protection and their competencies. Republic Administration of Civil Protection manages civil protection issues, under direct supervision of the Government and the Parliament. Implementation is undertaken through regional departments for civil protection sited in Banja Luka Doboj, Bijeljina and Sokolac. In the Brčko District, activities on defence from harmful effects of water are managed by the Civil Protection Centre, established by a decision of the Brčko District Government.
Serbia	- Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia – Water Directorate - Ministry of Interior – Emergency management sector, Operational Headquarter of the Republic Headquarters for Emergency Situations - Provincial Secretariat for Agriculture, Water Management and Forestry of Vojvodina - Public water management company „Srbijavode" - Public water management company „Vode Vojvodine" - Republic Hydrometeorological Service of Serbia	On category I watercourses and drainage systems in public property flood protection is undertaken by the competent public water management company, in line with the General Flood Defence Plan and the Operational Flood Defence Plan, while waters of the II category are the responsibility of local self-government units.
Montenegro	- Ministry of Agriculture and Rural Development – Directorate for Water Management - The Water Administration - Ministry of Interior – Directorate for Emergency Management - Institute of Hydrometeorology and Seismology	The General plan for the protection against harmful effects of water defines works and measures, modes of institutional organization, responsibilities and competencies of institutions and other bodies competent for defence from harmful effects of water, as well as collection and recording of data, forecasting and information. Operational plans for the protection against harmful effects of water define measures for effective protection implementation. Local self-government units adopt protection plans for waters of local significance.

8.3.1 Recommendations for improving cooperation

Based on experiences gained prior, during and after the May 2014 floods, emergency operations in the Sava River basin shall be improved if both horizontal and vertical responsibilities are clearly defined, methodology for assessing of a disaster consequences by sectors is established (e.g. people care, agriculture, animal evacuation, land cleaning of soil, etc.), obligations of local utility companies in the management of waste induced by the flood are defined, as well as plan and the capacity to care for people affected by the disaster is in place, and detailed plans for handling of cultural institutions and the owners/users of cultural property in the time of crisis are prepared.

Through the analysis of the existing regulatory framework, bilateral agreements, operational plan and available Standard Operational Procedures[27], as well as the results of the transboundary training workshop "Governance and technology for flood risk reduction: Linking early warning to emergency management in the Sava River basin" held in Zagreb from 5 to 7 December 2017, the following issues and needs for cooperation improvements were identified, with related recommendations.

- **Border-crossing procedures for import and export of protection and rescue equipment and delivery of humanitarian aid should be simplified, made easier and quicker**. Defined by agreements, and confirmed by the May 2014 floods, is that the parties need unified templates which would be given to competent authorities when crossing borders, which would speed up the protection and rescue processes. It is recommended to support adoption and use of procedures based on unified templates for "Information on disaster", "Request for assistance", "Offer for assistance" etc, with the goal of speeding up communication between countries and implementation of protection and rescue actions. Similar is recommended for Standard Operational Procedures (SOP) and protocol for border-crossing procedures prepared within the IPA Floods project. Mentioned templates, documents and procedures create more effective legal, planning and operative conditions for uninterrupted actions in flood defence emergency situations;
- **Population awareness in flood areas is of high importance for reducing flood risks.** Providing risk information based on national flood hazards and risks maps. It is necessarry to educate and continuously warn the population about the potential of flooding, especially in areas of high potential flood risk, as well as about measures for flood defence and self-protection. Institutions responsible for protection and rescue should regularly issue instructions for the public on how to act in emergency situations and which prevention measures should be timely undertaken to avoid or reduce the consequences;
- **Work is needed on promotion and creation of national, regional and international multi-stakeholder technical workshops, forums and roundtables for Civil Protection emergency planning**, using among others the Sava Commission as a platform for mutual cooperation, that would assemble interested stakeholders in planning and implementation of civil protection in

[27] Standard Operational Procedures is an action document of a bilateral agreement on cooperation in protection from natural and civil disasters, by which the signatories agree on mutual conditions for providing crossborder aid

emergency situation, with the goal to clarify procedures, responsibilities and means available to all relevant bodies (public and private);

- **For timely responsein emergency situations, information is needed in the shortest possible timeframe and their dissemination in a safe and reliable way to emergency management centres**, which then further act according to defined procedures. Accordingly, it is necessary to standardize the procedure of dissemination of warnings via the Common Alerting Protocol (CAP), allowing warning message to be broadcasted simultaneously over the most relevant media channels through a dedicated application. At the same time, the Sava FFWS system should be adjusted for use in international alerts between Sava River basin countries, and regulate its usage at the basin level and at other basins in the countries;
- **Development of flood emergency management plan / contingency plan at the basin level would facilitate a coordinated approach**, to allow the sharing of best practices, information, and data, as well as to codify and structure all actions that the civil protection system ought to enact while increasing its responsiveness;
- **It is recommended to share adjusted information from Sava FFWS, Sava HIS and Sava GIS systems, according to needs and competencies of institutions and users.** This includes support and work on improving the system for increasing the quality and quantity of available information. Policy on the exchange of data and information[28]. should ensure access and distribution of data and information for further review and modelling, to create a more effective platform for decision making and joint action. In order to avoid overlap and increase the number of users of benefits and capabilities of new technologies, it is recommended to jointly plan and implement projects for improving the use of innovative technologies. For example, the interface between early warning services performed by the Sava FFWS with reactive monitoring and response could couple flood warnings with additional relevant data e.g. in-field reports. This kind of link would provide strong support to capacity of decision makers, improving the situational awareness at all stage of the emergency cycle by enhancing monitoring and the communication flow across borders and organizations while involving citizens;
- **Volunteers provide efficient action in flood defence emergency situations in synergy with competent authorities in the countries.** It is therefore needed to initiate discussions on potential for actions and integration of volunteer organisations in existing emergency management systems on all levels (international, national and local). This would also provide additional value through capacities and necessary manpower, as well as creation of a communication channel between and towards the citizens.

[28] http://www.savacommission.org/dms/docs/dokumenti/documents_publications/basic_documents/data_policy/data_exchangepolicy_en.pdf

9 Public information and consultation

Public information and consultations process was an integral part of Sava FRMP preparation. The main purpose of this process was achievement of active participation of stakeholders during the Plan preparation, and adequate provision of information to the public along with a reasonable time period for submission of comments and proposals for amending the draft document.

Public information and consultation processin the Plan preparation ensured:

- Better awareness of stakeholders with regard to objectives, content, activities, as well as other aspects of the Plan;
- Improved quality of the draft Sava FRMP through comments received from stakeholders;
- Creation of appropriate conditions for implementation of the Plan, assuming that informed and aware stakeholders who participated in the Plan preparation will be readier to support its implementation.

During the identification of stakeholders that should be involved in the Sava FRMP preparation three specific groups were recognised:

1. Institutions from the Sava River basin countries, international institutions, as well as other similar stakeholders that were not necessarily been directly involved in the preparation of the draft Sava FRMP, but whose competences and activities make them relevant for the preparation and implementation of the Plan;
2. Non-governmental organizations, especially those dealing with environmental protection;
3. Public in the most general sense - population and organisations in Sava River Basin countries.

It was assumed that the participation of a larger number of stakeholders, with proper selection of the method of their participation, should contribute to better quality of the document and its better compatibility with different social interests and opinions.

In accordance with the above identified stakeholder groups, the following forms of public information and consultations were applied:

1. Information through the internet, including information about the development of theSava FRMP which were publicly available on the official website of the Sava Commission;
2. Informationthrough various publications and events organised by the Sava Commission, including information prior to the start of development through *Sava NewsFlash* publication produced by the Sava Commission, which was distributed to more than 200 stakeholders at different events and meetings. The publication was also published on the Sava Commission website;
3. Access to the draft Sava FRMP through the official website of the Sava Commission, with the option to provide comments in a certain timeframe. Comments on the draft Plan submitted within this time period were considered, with provision of appropriate feedback on whether the comment was accepted completely or partially, or not accepted;

4. Stakeholder Forum, which was organized to present the draft Sava FRMP, with plenary discussion and expert group work.

A summary of public information and consultation measures taken, their results and the changes to the plan made as a consequence can be found at:

http://www.savacommission.org/sfrmp/en/

10 Key findings

Conclusions drawn from preliminary flood risk assessment in the Sava River basin

In Sava FRMP the results of the national preliminary flood risk assessments and the joint report on preliminary flood risk assessment prepared for the Sava River basin, as well as other data processed during the preparation of this Plan were analysed. Based on analysis of 1,926 areas with potentially significant flood risk defined at the national level, 251 areas with basin-wide importance were identified. These areas were further grouped into 21 area of mutual interest for flood protection (AMI areas), as the basic elements for the Sava FRMP analyses and a framework for identification of non-structural and national structural measures that may contribute to achieving flood risk management objectives of the common interest in the basin. Total surface of AMIs is 5,659 km^2, which is 5.8% of the total Sava River basin surface, and a home to 1.4 million people.

Conclusions drawn from the national flood hazard and risk maps

Conclusions made from available national flood hazard and risk maps are based on the national data and information and elements of flood risk management planning. Proposal of elements for development of a joint methodology for preparation offlood hazard and risk maps for AMI areas in the Sava River basin was prepared, which can be used as a starting point for further adjustments and improvements, if there is a need for use of such a methodology in joint projects.

It is important to note that before the Sava FRMP, flood hazard and risk maps on the Sava River basin level haven't been considered. Although flood maps were not available for all the countries, for each of AMIs the areas with or without flood hazard were dentified with an indicative assessment of number of affected population and economic activity.

Objectives of flood risk management of mutual interest in the Sava River basin

Sava FRMP defines flood risk management objectives of mutual interest at the basin level, allowing mutual cooperation of the countries in implementing the Protocol provisions and joint measures and activities. Flood risk management objectives are based on previous experiences in flood risk management, disaster events which have been occurring relatively often in the last two centuries, as well as examples of best practices (green infrastructure, and natural management of waters which simultaneously provides flood protection and protects the natural environment), new technologies, better information to the public, and other, and are tailored to the needs of reducing flood risk in the Sava River Basin.

Non-structural and structural measures

Results of the analyses showed that the main causes for not reaching the national objectives of sufficient flood risk management are, among others, lack of financial sources and capacities for maintaining protection structures, but also the inability to implement measures due to environmental conditions.

Within the Sava FRMP 42 non-structural measures were identified and divided into 11 groups, as well as 38 national structural measures in areas of mutual interest with a total value of over 250 million €. The Sava FRMP also considers synergy of these measures to

the Sava RBMP, and provides preliminary analyses of measures according to various parameters.

Implementation of measures, and development of new facilities and systems for reducing potential harmful effects of floods to human health, environment and economic activities should take into account the objectives of natural protection, provide more space to the rivers, and support those activities that do not cause significant increase of flood risks. The Sava FRMP includes measures for provision of more space for natural retention of water and recovery of previously flooded areas, better spatial planning, information exchange, improvements to data collection systems, as well as modelling and forecasting, and warning systems. The need for regular maintenance of flood protection structures was emphasised, as well as the reconstruction and construction where necessary, and where no other measures are possible to prevent catastrophic consequences.

Special importance during the identification of non-structural measures was given to data collection, preparation of studies and other activities aimed at improving the planning basis for the next planning cycle.

Coordination mechanisms

Having in mind disastrous floods in the recent years, especially those in May 2014, as well as the increasing effects of climate change causing increased frequency and intensity of flood events, it is necessary to act co-ordinated, wherever possible, to plan and intensify joint implementation of measures of mutual interest for several countries, meaning for the entire Sava River basin. Sava FRMP provides a number of recommendations for improving the mutual cooperation in the Sava River basin.

11 References

- Action Plan for the Sava River Sub-Basin as a part of the Action Programme on Sustainable Flood Prevention in the Danube River Basin, ICPDR (2009)
- Assessment of flood risk hazard and risk maps, member state report, Croatia (2015)
- Assessment of flood risk hazard and risk maps, member state report, Slovenia (2014)
- Brčko District BIH Statute (Official Gazette of Brčko District BIH, no. 2/10)
- Guidance for Reporting under the Floods Directive (2007/60/EC), DG Environment (2013)
- Directive on the assessment and management of flood risk (2007/60/EC)
- Federal Operational Flood Defence Plan FBIH (Official Gazette BiH, no. 97/15)
- Building the link between Flood Risk Management planning and climate change assessment in the Sava River Basin, Sava Commission (2013)
- Water and Climate Adaptation Plan for the Sava River Basin - WATCAP, Sava Commission (2015)
- Flood and landslide risk assessment for the housing sector in BIH (2015)
- Flood hazard and risk maps for the Danube River basin, ICPDR (2015)
- Flood protection and rescue plan, Slovenia (2004)
- Flood Risk Management Plan for the Danube River basin, ICPDR (2015)
- Flood Risk Management Plan, Slovenia
- Framework Agreement on the Sava River Basin (2004)
- General Flood Defence Plan for the period 2012-2018, Republic of Serbia (Official Gazette of RS, no. 23/12)
- General plan for the protection against harmful effects of water, Montenegro (Official Gazette of MN, no. 17/17)
- Global flood depth-damage functions: Methodology and the database with guidelines. JRC Technical Report. European Commission (2017)
- Guidance document No. 24 River Basin Management in a Changing Climate (2009)
- Guide to Cost-benefit Analysis of Investment Projects – Economic appraisal tool for Cohesion Policy 2014-2020 (2014)
- Guidelines for Standards for Flood Protection and Safety (2014)
- Guidelines for the implementation of a Cost Benefit Analysis in flood risk management (2014)
- IWRM study and plan – basic information, Montenegro (2016)
- Law on Emergency Situations, Republic of Serbia (Official Gazette of RS, no. 111/09, 92/11 and 93/12)
- Law on Government of the Brčko District BIH (Brčko district BiH Official Gazette, no. 22/18)
- Law on Ministries and other administration bodies of Bosnia and Herzegovina (Official Gazette of BIH, no. 5/03, 42/03, 26/04, 42/04, 45/06, 88/07, 35/09, 59/09, 103/09, 87/12, 6/13, 19/16)
- Law on Protection and Rescue of People and Material Property from Natural and Other Disasters, FBiH (Official Gazette FBiH, no. 39/03, 22/06 and 43/10)
- Law on Protection and Rescue of Montenegro (Official Gazette of MN, no. 13/07, 5/08, 86/09, 32/11, 54/16)
- Law on rescue and protection in emergency situations of Republika Srpska (Official Gazette of RS, no. 121/12 and 46/17)
- Law on Protection from Natural and Other Disasters, Slovenia (Official Gazette, no. 51/06, 95/07 and 97/10)
- Law on Water FBiH (Official Gazette FBIH, no. 70/06)
- The Water Act of Croatia (Official Gazette, no. 153/09, 63/11, 130/11, 56/13, 14/14 and 46/18)
- Law on Waters of Montenegro (Official Gazette MN, no. 27/07, 32/11, 47/11, 48/15, 52/16, 2/17, 22/16, 80/17)
- Law on Waters of the Republic of Serbia (Official Gazette of RS, no. 30/10, 93/12, 101/16)

- The Waters Act of the Republic of Slovenia (Official Gazette RS no. 67/02, 57/08, 57/12, 100/13, 40/14, 56/15)
- Water Law of Republika Srpska (Official Gazette, no. 50/06 and 92/09)
- Memorandum of Understanding on cooperation between the International Sava River Basin Commission and Montenegro (2013)
- Methodology for preparation of flood hazard and risk maps on watercourses of I category in FBIH (2013)
- The National Strategy for Emeregency Situations, Montenegro (2007)
- National Flood Defence Plan of Croatia (Official Gazette, no. 84/10)
- Preliminary Flood Risk Assessment for category I watercourses in FBIH, BIH (2013)
- Preliminary Flood Risk Assessment for Republika Srpska, BIH (2014)
- Preliminary Flood Risk Assessment in the Sava River Basin, PFRA (2014)
- Preliminary Flood Risk Assessment in the Sava River Basin, Republic of Croatia: Danube River basin and Adriatic Sea area (2013)
- Preliminary Flood Risk Assessment, Serbia (2011)
- Preliminary Flood Risk Assessment, Slovenia (2011)
- Preparation of flood hazard and risk maps for Vrbas sub-basin in BIH – Annex 6, project "Climate change integration into flood risk reduction in River Vrbas basin" (2016)
- Program for common EU water management policy, project for preparing basis for Flood Directive implementation (2007/60/EC), work report of the Institute for Water of the Republic of Slovenia, Ljubljana (2014)
- Program for development of Flood Risk Management Plan in the Sava River Basin (2013)
- Protocol on flood protection to the FASRB (2010)
- Decree on the Federal Centre for Civil Protection, FBIH (Official Gazette of FBIH, no. 54/03, 38/06, 74/07 and 63/11)
- Decree on types and content of the plans for protection from harmful water operations, FBiH (Official Gazette BiH, no 26/09)
- Report on floods in the Sava River Basin in May 2014 (2015)
- Sava River Basin Management Plan, RBMP (2014)
- Rulebook on content and preparation of protection and rescue plans Slovenia (Official Gazette, no. 24/12 i 78/16)
- Rulebook on the detailed content of preliminary flood risk assessment and the plan of flood risk management, Montenegro (2015)
- Rulebook on determining the methodology for preparing flood hazard and risk maps, with the methodology for preparing flood hazard and risk maps, Republic of Serbia (Official Gazette of RS, no. 13/2017)
- 1st Sava River Basin Analysis, 1st SRBA (2009)
- 2nd Sava River Basin Analysis, 2nd SRBA (2017)
- Sava White Book - The River Sava: Threats and Restoration Potential (2016)
- The Water Framework Directive (2000/60/EC)
- Water Management Financing Act, Croatia (Official Gazette, no. 153/09, 90/11, 56/13, 154/14, 119/15, 120/16, 127/17)
- Water Management Strategy of Croatia (Official Gazette, no 91/08)
- Water Management Strategy of FBIH 2010-2022 (2010)
- Water Management Strategy for the territory of Republic of Serbia until 2034 (Official Gazette of RS, no. 3/2017)
- Water Management Strategy of Slovenia
- Water Management Strategy, Montenegro (2017)
- Water Regions Management Plan for the period 2016 – 2021, which includes the Flood Risk Management Plan for the Republic of Croatia (Official Gazette, no 66/16)

Annexes

Annex 1
List of competent authorities and institutions for protection against harmful effects of water in the Sava River Basin

List of competent authorities and institutions for protection against harmful effects of water in the Sava River basin

Country	Competent Institution	Address	Website
Slovenia	Ministry of Environment and Spatial Planning	Dunajska cesta 48, 1000 Ljubljana, Slovenia	www.mop.gov.si
	Ministry of Environment and Spatial Planning, Slovenian Water Agency	Hajdrihova ulica 28c, 1000 Ljubljana, Slovenia	www.dv.gov.si
	Ministry of Environment and Spatial Planning, Slovenian Environmental Agency	Vojkova 1b,1000 Ljubljana, Slovenia	www.arso.gov.si
Croatia	Ministry of Environment and Energy, Directorate for Water Management and Protection of the Sea	Ulica grada Vukovara 220, 10000 Zagreb, Croatia	www.mzoip.hr/hr/vode.html
	Croatian Waters (Hrvatske vode)	Ulica grada Vukovara 220, 10000 Zagreb, Croatia	www.voda.hr
Bosnia and Herzegovina	Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina	Musala 9, 71000 Sarajevo, Bosnia and Herzegovina	www.mvteo.gov.ba
	Federal Ministry of Agriculture, Water Management and Forestry	Marka Marulića 2, 71000 Sarajevo, Bosnia and Herzegovina	fmpvs.gov.ba
	Sava River Watershed Agency	Hamdije Čemerlića 39a, 71000 Sarajevo, Bosnia and Herzegovina	www.voda.ba
	Ministry of Agriculture, Water Management and Forestry of Republika Srpska	Trg Republike Srpske 1, 78000 Banja Luka, Bosnia and Herzegovina	www.vladars.net/sr-SP-Cyrl/Vlada/Ministarstva/mps
	Public Institution "Vode Srpske"	Miloša Obilića 51, 76300 Bijeljina, Bosnia and Herzegovina	www.voders.org
	Department for Agriculture, Forestry and Water Management of Brčko District BiH	Bulevar mira 1, 76100 Brčko, Bosnia and Herzegovina	www.bdcentral.net/index.php/ba/odjeljenja-vlade-brko-dsitrikta-bih/poljoprivreda-umarstvo-i-vodoprivreda
Serbia	Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia – Water Directorate	Bulevar umetnosti 2a, 11000 Belgrade, Serbia	www.rdvode.gov.rs
	Provincial Secretariat for Agriculture, Water Management and Forestry of AP Vojvodina	Bulevar Mihajla Pupina 16, Novi Sad, Serbia	www.psp.vojvodina.gov.rs
	PWMC „Srbijavode"	Bulevar umetnosti 2a, 11000 Belgrade, Serbia	www.srbijavode.rs
	PWMC „Vode Vojvodine"	Bulevar Mihajla Pupina 25, Novi Sad 21000, Serbia	www.vodevojvodine.com
Montenegro (not a party to the Framework Agreement, but participating based on the Memorandum)	Ministry of Agriculture and Rural Development – Directorate for Water Management	Rimski Trg 46, 81000 Podgorica, Montenegro	www.minpolj.gov.me/organizacija/vodoprivreda
	The Water Administration	Bulevar Revolucije 24, 81000 Podgorica, Montenegro	www.upravazavode.gov.me

Annex 2
List of multilateral and bilateral agreements of importance for flood risk management in the Sava River basin

List of multilateral and bilateral agreements of importance for flood risk management in the Sava River basin

Multilateral contracts and agreements

Beside the Framework Agreement on the Sava River Basin, four protocols have been adopted: Protocol on Navigation Regime, Protocol on Flood Protection, Protocol on Prevention of Water Pollution Caused by Navigation, Protocol on Sediment Management, as well as the Program for development of Flood Risk Management Plan in the Sava River Basin. For cooperation of countries in the Sava River basin, the following international documents are also important:

- The Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention UN/ECE – Helsinki, 1992);
- Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention, 1991);
- Protocol on strategic environmental impact assessment to the Convention on Environmental Impact Assessment in Cross-Border Context (SEA Protocol - Kiev, 2003);
- Convention on Access to Information, Public Participation and Access to Justice in Environmental Matters (Aarhus Convention, 1998);
- Convention on the Protection of the Danube River (Sofia, 1994);
- Convention on Navigation Regime on the Danube River;
- Protocol on the European Pollutant Release and Transfer Register (Kiev 2003).

Bilateral agreements of importance for flood management in the Sava River Basin

In addition to multilateral cooperation maintained by the countries in the Sava River basin based on the Framework Agreement and other international documents, there are also other forms of bilateral cooperation between individual countries, including the following agreements:

- Contract between the Government of the Republic of Croatia and Government of Bosnia and Herzegovina on regulation of water management relations (competent authority: Committee for Water Management of the Republic of Croatia and Bosnia and Herzegovina);
- Contract between the Government of the Republic of Croatia and Government of the Republic of Slovenia on regulation of water management relations (competent authority: Standing Croatian-Slovenian Commission for Water Management);
- Contract between the Government of the Republic of Croatia and Government of the Republic of Montenegro on mutual relations in the area of water management (competent authority: Standing Croatian-Montenegrin Commission for Management of Waters of Common Interest).

In addition to the above signed bilateral agreements, it is noted that the need for bilateral regulation of cooperation between the riparian countries has been recognised in their strategic documents. Thus, the Water Management Strategy of the Republic of Serbia, within the sections pertaining to the Sava River basin, reads that all water management issues should be addressed through the Sava Commission, but it also recognises the need for signing bilateral agreements between neighbouring countries within the basin. The

Water Management Strategy of Montenegro also recognises the importance of cooperation within the basin through the Sava Commission, stating that it is in the interest of Montenegro to sign bilateral agreements with Serbia and Bosnia and Herzegovina in the field of water management.

Bilateral agreements in the area of rescue and protection

Table 17 contains a list of the existing bilateral agreements and Standard Operational Procedures (SOPs) in the area of protection and rescue, and provision of support in case of natural or other disasters, between the countries in the Sava River Basin:

Table 17: Existing bilateral agreements and Standard Operational Procedures

Country	Bosnia and Herzegovina	Slovenia	Croatia	Serbia	Montenegro
Montenegro	Yes and SoP	Yes	Yes	Yes and SOP	x
Serbia	Yes	Yes	SoP	X	Yes and SOP
Croatia	Yes	Yes	X	SoP	Yes
Slovenia	Yes	x	Yes	Yes	Yes
Bosnia and Herzegovina	x	Yes	Yes	Yes	Yes and SOP

It comes out from the analysis of the existing bilateral agreements that countries, with the exception of Croatia and Serbia, have concluded bilateral agreements to regulate their mutual relations and cooperation in the protection against natural and other disasters. Additionally, the Ministry of Interior of Montenegro and Ministry of Interior of the Republic of Serbia, based on the agreement signed by governments of Montenegro and Serbia on cooperation in protection against natural and other disasters, have developed and adopted Standard Operational Procedures to more closely regulate the process of mutual notification about hazards, manner of border crossing, bringing the materials into and out of the country and transport thereof in the activities of protection and rescue, and use of aircrafts for transport of rescue teams and aid. Based on the agreement signed by the Council of Ministers of Bosnia and Herzegovina and Government of Montenegro on cooperation in the protection against natural and other disasters, the Ministry of Interior and public administrations of Montenegro and Ministry of Security of Bosnia and Herzegovina have developed and adopted Standard Operational Procedures to regulate framework conditions for cooperation in providing cross-border assistance in case of natural and other disasters.

Annex 3
Proposal of elements for development of a joint methodology for preparation of flood maps for the whole Sava River basin

Proposal of elements for development of a joint methodology for preparation of flood maps for the whole Sava River basin

Article 7 of the Protocol provides that Parties may agree on the development of joint methodology for the preparation of flood hazard maps and flood risk maps for areas with potentially significant flood risks identified as a result of the PFRA, and/or areas of mutual interest for the entire Sava River basin.

The joint methodology for the preparation of flood maps in the Sava River basin is primarily related to flood areas shared by two or more countries and it takes into account the fact that all the countries in the basin had already developed or are working on defining the national methodologies.

Taking into account the complexity of the harmonisation of the above mentioned preconditions, drafting of the Sava FRMP included a proposal of elements for development of a joint methodology for preparation of flood maps in the Sava River basin, which can serve as the starting point for future improvements and enhancement if there is a need to use such a methodology for the sake of joint projects.

Elements of the presented methodology for the preparation of flood maps in the Sava River basin are being defined for the first time and they represent a starting point for further elaboration. This methodology proposal is based on the concept of defining the flood risks by making inventory of risk receptors affected by a certain degree of hazard (depth class) for a certain flood return period, while not quantifying individual damages. In this way, the concept of risk is observed in wider framework and besides the economic risk, other forms of risk are also taken into account. According to the proposal for each receptor, it is necessary to define a measurement unit for it. Since receptors can have different dimensions (e.g. affected population and residential buildings are measured in numbers, agricultural land in surface [m^2], roads in length [m], and so on…), a common measurement indicator was introduced – the "module" (a sum of receptors), with the idea to define the scope of risk with a sum of receptors per unit of respective surface. Although modules have different dimensions according to the receptor type [number, m, m^2], the value of a module per surface unit is a "specific weight" linked to floods, or a "specific risk" of flooding, thus bringing all receptors under a "common nominator".

The proposed elements of the simplified methodology serve as a basis for the development of flood maps for areas of mutual interest in the whole Sava River Basin.

Flood hazard maps on the Sava River basin level should be developed for the following two scenarios:

- Floods with medium occurrence probability (100-year return period);
- Floods with low occurrence probability, including extreme events, but this scenario should be tailored to specific needs for which the subject methodology will be developed (regardless of the return period).

Aside from the two scenarios above, hazard maps will be prepared for other scenarios according to national methodologies of countries involved in a joint project for which there is a need to prepare the maps.

The following risk receptors are proposed:

1. Indicative population;

2. Economic activities;
3. Environment;
4. Cultural-historic heritage.

If no data of sufficient quality is available, it is recommended to use the following data sources:

- Statistical data about population (number) and settlements (number of settlements in the hazard area);
- Corine data classified into several categories (all agricultural activities, economic activities, infrastructure (in km^2));
- Protected areas according to the EU WFD requirements or defined within the Sava RBMP, areas according to Natura 2000, national parks, protected natural values (areas for conservation of species and habitats, water protection areas and bathing resorts), and potential significant polluters, such as large installations, waste disposal sites and waste water treatment plants);
- Significant infrastructural objects according to data provided by competent institutions (presented as a number and length/space, depending on geometry);
- Cultural heritage register.

Flood hazard maps

Analysing the similarities of existing national division of classes, the following classification and visual interpretation of flood hazard maps has been proposed, according to the depth parameter:

Class	Class delimitation
	h
Class 4	< 0.50
Class 3	0.50 - 1.50
Class 2	1.50 - 2.50
Class 1	> 2.50

Hazard maps, as a result of hydraulic calculations for each scenario, should contain at least:

- Flood areas borderlines – flood areas borderlines defined as envelope curves for different flood sources;
- Distribution of flooding depths.

Flood risk maps

Elements of the simplified joint methodology for preparing flood risk maps are based on assessment of risk by making an inventory (counting) of data on risk receptors. The methodology proposes to introduce a "risk module", which is a sum of receptors, with the objective that each risk receptor regardless of its dimension [number, m, m^2] can be uniquely quantified by the value of its module. Value of the risk module per the land surface unit would give the specific flood risk.

Effect of flood hazard on increase of the flood risk according to this methodology would be expressed by the flood depth, which values would be presented in the hazard maps.

Flood risk for each receptor category would be expressed by the risk factor, as a result of specific risk (area vulnerability) multiplied by the flood depth (flood area hazard).

For each scenario, on the risk map would be shown the scope of the flooding with that depth parameter. According to the methodology, flood risk maps would show potential harmful consequences linked to two flood scenarios (middle and low) in relation to the affected population, type of economic activity, possibility of sudden pollution with a focus on protected areas, and other information considered useful. Flood risk maps defined in such a way wouldn't follow the usual definitions of risk (combination of probability and effects of the flood event), but would show flooding of risk receptors in the defined scenarios. In this simplified manner, the information should be easier to understand, not only for the experts in this field, but also the wider public.

Annex 4
Proposal of elements of a simplified methodology for cost-benefit analysis of measures implementation

Proposal of elements of a simplified methodology for cost-benefit analysis of measures implementation

Simplified methodology for cost and benefit analysis has been proposed (hereinafter: CBA methodology) for preliminary comparison of measures based on CBA parameters, in situations when certain measures have not yet passed through a reliable CBA study as a part of technical preparation, most commonly in a feasibility study.

The proposed methodology is based on the following references: 1) Guide to Cost-benefit Analysis of Investment Projects – Economic appraisal tool for Cohesion Policy 2014-2020[29]; 2) Guidelines for the implementation of a Cost Benefit Analysis in flood risk management[30]; 3) Guidelines for Standards for Flood Protection and Safety[31]; 4) Report Preparation of Expert Basis for Implementation of the Flood Directive in Republic of Slovenia[32]; 5) EU JRC Technical Report: Global flood depth-damage functions: Methodology and the database with guidelines[33].

Methodology basics

Economic benefits of a measures are equal to monetary amount of avoided damages, and can be calculated as a discrepancy between the amount of damages that would occur in case that no measure is applied and amount of damages occurred in case of application of measures.

Economic benefits (EUR) = *Damage before the application of measures (EUR) – Damage after the application of measures (EUR)*

Flood-related damages can be classified according to two criteria:

- depending on type of property damaged, there are „tangible" damages, which can easily be expressed in monetary terms, and „intangible", which pertain to goods not exchanged on the market, therefore cannot easily be expressed in money;
- depending on negative event which caused the damage, and the nature of the damage, there are „direct" damages occurred due to flood event itself, and „indirect" ones, occurred as secondary effect of the flood.

There are two types of costs that should be addressed within a CBA:

- direct costs: capital, operational and maintenance costs;
- indirect costs: e.g. salaries of people responsible for implementation of measures.

Economic benefit assessment should include damages on goods that have market price, as well as damages on goods and services for which there is no market price. Taking into account that there is no much available information for riparian countries in the Sava River basin that could be used to assess economic benefits for all potential groups of risk-related

---

[29] http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/cba_guide.pdf

[30] http://www.floodcba.eu/main/wp-content/uploads/Cost-Benefit-Analysis-Guidelines1.pdf

[31] http://www.floodcba2.eu/site/wp-content/uploads/Guidelines-FLOODCBA2-v-3-10.pdf

[32] Program Common EU Policy to Water, Project Preparation of Expert Basis for Implementation of the Flood Directive (2007/60/EC), Report on the work of the Institute for Water of the Republic of Slovenia, Ljubljana, 2014

[33] Huizinga, J., De Moel H., Szewczyk, W. (2017). *Global flood depth-damage functions: Methodology and the database with guidelines.* JRC Technical Report. European Commission. http://publications.jrc.ec.europa.eu/repository/bitstream/ JRC105688/global_flood_depth-damage_functions__10042017.pdf

elements, the simplified methodology includes the following groups of elements for which there is data available:

Table 18: Benefits of measures for flood risk reduction per element group

Groups of risk-related elements	Benefits of flood risk reduction measures
Human health	Avoided injuries and fatal outcomes among population
Environment	Avoided environmental damages
Economic activity	Avoided damage on residential, economic and agricultural facilities
	Avoided damage on public infrastructure (roads)
	Avoided agricultural damages (land and crops)
	Avoided transport damages

Economic benefits gained through avoidance of damages when flood risk reduction measures are applied, are calculated through the following general equation:

Expected damage in flooded area at Q_T = *Dimension × Exposure × Vulnerability× Value*

Expected damage in flooded area in different return periods Q_T (e.g. Q_{10}, Q_{20}, Q_{50}, Q_{100}) is expressed in monetary units (e.g. in Euro).

Dimension means surface, number or other value of spatial elements in selected area (e.g. population, number of buildings, length of road infrastructure).

Exposure means probability that spatial elements are present in selected area in certain time period (e.g. employees stay at work 8 out of 24 hours a day).

Vulnerability means a degree of damage made to spatial elements in selected area for events of a certain intensity (e.g. the damage is expressed as a percentage of total value).

Value of damage to certain element is expressed in monetary units, i.e. Eur/unit (e.g. EUR/m of road infrastructure, EUR/m² of residential area).

Simplified CBA methodology includes the **following groups of risk-related elements**. Description of each group is subject to changes by the methodology users.

Human health

Calculation of economic benefits is based on determination of number and disposition of population affected by floods. Value of economic benefits in monetary amount is defined as benefit of proposed measures generated as a result of avoided injuries, illnesses and fatal outcomes among population caused by floods. As a result of this part of the model, the following values are obtained and expressed in monetary amount: 1) economic benefits based on avoided damages in case of casualty; 2) economic benefits based on avoided damages in case of injuries.

Environment

Floods affect the environment and ecosystem services. In case of floods, provision of clean drinking water to population is interrupted, and there is also land and water pollution. Economic benefits in this segment are observed through avoided damages/costs, which occur in case of flood with return period „T". As a result of this part of the model (economic benefits in the environment), economic benefits are calculated based on avoided damages of reduction in aesthetic value of environment and degradation of quality of services depending on biodiversity.

Economic activity

The calculation of economic benefits in the sense of the avoided damage in the area of economic activity includes the following elements: 1) affected area where residential buildings are located; 2) affected area where there are commercial and agricultural facilities and land; 3) affected area where public infrastructure (national and local roads) is located and where transport activities are carried out. Each element located in the subject affected area is represented through surface (area of land in square meters) for each of the analysed Q_T periods. Using this model, monetary values of economic benefits are obtained on the basis of avoided damage to residential, business and agricultural facilities; public infrastructure and transport; agriculture; basic and working assets of companies.

Remarks

Simplified methodology proposes a CBA model and the approach for the use thereof, which would allow for an indicative comparison of a specific set of measures based on CBA parameters. It should be noted that although cost and benefit analysis contains very important part of information necessary for decision making, it is not a sole mechanism for selection between alternative measures. Decisions related to flood risk management, both at strategic and project level, may be the result of a combined effects of a lot of factors, including technical, economic and socio-political considerations. Flood protection *per se* is not a result of a purely economic agreement, nor can all the considered elements be expressed in monetary terms, which of course does not reduce the significance and usefulness of cost-benefit analysis as an important tool for decision making processes. Therefore, the use of simplified CBA methodology is proposed as part of a wider multi-criteria analysis, which would allow for an overview of various aspects of significance of a particular measure for the Sava River basin with regard to other proposed interventions.

Although the simplified methodology can serve as one of the criteria of such an analysis, it should be verified and if necessary corrected through a detailed CBA study as part of the measure feasibility assessment which would, based on a more comprehensive research, provide more accurate results of cost/benefit ratio for the assessed measure, or its variant solutions.

Annex 5
Overview of elements used in preparation of flood maps according to national methodologies

Table 19: Overview of elements used in preparation of flood hazard maps according to national methodologies

Requirements of the EU Floods Directive	SI	HR	BA	RS	ME
Low probability return period (years)	500		500	1000	500
Medium probability return period (years)	100	100	100	100	100
Categories of water depth	< 0.5 m ≥ 0.5 m and < 1.5 m ≥1.5 m	<0.5 m 0.5 – 1.5 m 1.5 – 2.5 m >2.5 m		<0.5 m 0.5 – 1.5 m 1.5 - 4 m >4 m	< 0.5 m 0.5 – 1.5 m > 1.5 m
Hazard classification	▪ high degree of hazard – water depth ≥1.5 m or water depth and velocity multiplied ≥1.5 m2/s, ▪ medium degree of hazard – water depth ≥ 0.5 m and < 1.5 m or water depth and velocity multiplied ≥ 0.5 m2/s and < 1.5 m2/s, ▪ low degree hazard – water < 0.5 m or water depth and velocity multiplied < 0.5 m2/s, and ▪ very low degree of hazard – where flood occurs due to unusual natural or artificial causes (e.g. unusual meteorological phenomena or breakdown, or failure in flood protection and other water structures etc.).	Non classified	▪ Class 0 – Negligible hazard (hazard value 0.75) – low hazard, ▪ Class 1 – Certain categories are endangered (children, elderly ones, ill persons, non-swimmers…) – (hazard value from 0.75 to 1.5) – moderate hazard, ▪ Class 2 – Majority of population is endangered (hazard value from 1.5 to 2.5) – high degree of hazard, ▪ Class – Hazard for all in the flood plain (hazard value exceeding 2.5) – extreme hazard.	Non classified	Non classified

Table 20: Overview of data contained in flood risk maps according to national methodologies

Requirement of the EU Floods Directive	SI	HR	BA	RS	ME
Population (framework number)	Number of permanent or temporary inhabitants	Number of endangered population in settlements	Number of endangered population or population density	Number of population affected by floods	Number of potentially affected population
Type of economic activities	▪ Number of buildings with house number, ▪ Number of business entities, ▪ Estimated number of employees, ▪ Length of the main line infrastructure (km), ▪ Number of important buildings of social infrastructure of national importance.	Corine Land Cover: ▪ Settlements, ▪ Areas of economic activities, ▪ Intensive agriculture, ▪ Other agriculture, ▪ Forests and low vegetation, ▪ Wetlands and scarce vegetation, ▪ Aquatic areas. Infrastructure: ▪ Airports, ▪ Railway stations, ▪ River and marine ports, ▪ Bus stations, ▪ Hospitals, ▪ Schools, ▪ Kindergartens, ▪ Retired people's homes, ▪ Catchments, ▪ Transformer stations, ▪ Railways, ▪ Dykes, ▪ Motorways, ▪ Other roads.	▪ Residential buildings and households, ▪ Social buildings, ▪ Economy and agriculture, ▪ Roads.	Land use: ▪ Industrial production, commercial and service businesses, ▪ Agricultural land, ▪ Forests and other areas under natural vegetation, degraded coastal areas. Infrastructure: ▪ Transport infrastructure (roads, railways, supporting transport infrastructure – stations, airports, ports), ▪ Water management infrastructure (water-related facilities, facilities of importance for organisation and implementation of flood protection and activities in case of emergency), ▪ Energy infrastructure (transformer stations, gas lines, oil lines, heating lines, etc.), ▪ Telecommunication infrastructure. Buildings for vulnerable groups of population (hospitals, schools, kindergartens, elderly homes...).	▪ Types of economic activities in potentially affected area.
Installations from the Directive	▪ Area of potentially endangered (polluted) protected area	Environmental protection: ▪ Areas of protected habitats or species, ▪ National parks,	▪ IPPC/IED installations, which in case of floods can cause extreme negative effects.	Potential polluters: ▪ Installations and activities subject to integrated permitting,	▪ Potential pollution sources, activities and installations which could

Requirement of the EU Floods Directive	SI	HR	BA	RS	ME
96/61/EC which could cause sudden pollution in the event of flood	▪ Number of installations according to IPPC/IED Directives and establishments according to SEVESO	▪ Water protection areas, ▪ Bathing resorts, ▪ IPPC/IED and SEVESO II installations/establishments, ▪ Waste disposals, ▪ Waste water treatment plants.	▪ Protected areas (protected springs, protected areas and catchment zones).	▪ Installations (and activities) where hazardous substances are stored, used, produced or handles with – SEVESO establishments of the 1st and 2nd tier (plus details about the legal entity), ▪ Urban waste water treatment plant (capacity ES>2000), ▪ Sanitary landfill/ disposal sites for solid waste, ▪ Abandoned mining tailing ponds. Protected areas: ▪ Protected areas pursuant to the Law on Waters, ▪ Protected areas pursuant to the Law on Nature Protection.	cause sudden pollution in case of flood, ▪ data about potential hazards for protected areas
Cultural heritage	Cultural heritage: ▪ Number of cultural heritage units, ▪ Number of cultural monuments of national importance.	Cultural heritage: ▪ UNESCO areas.	Cultural-historic heritage: ▪ Religious buildings, ▪ Museums and other cultural activities, ▪ Historic monuments and protected buildings.	Cultural heritage: ▪ Protected monuments pursuant to the Law on the Protection of Cultural Monuments.	
Other information					▪ Areas where floods with high content of transported sediment and other sources of pollution can occur.

Annex 6
Summary of measures

Table 21: Summary of non-structural measures

Aspect	Code	Objective	Measure	Measure implementation area	Indicative Description of Activities	Indicative Priority	Indicative Implementation Period	Indicative Financing Sources
Prevention	M23	1	Promotion of best practice for integrated and sustainable flood risk management (use of green infrastructure, construction/relocation of residential and other objects from flood-prone areas, spatial planning etc...)	SRB	Workshop with participation of institutions responsible for construction, spatial planning and infrastructure; publication in Sava River countries' languages	medium	not defined	- European Union funds (financial instruments / funds) - Crossborder cooperation funds - National funds of the countries - International financial institutions - Bilateral donations and loans - Joint financial mechanisms and global funds
		1	Facilitate and speed up the process for the provision of mutual and international aid	SRB	Workshop with participation of institutions responsible for emergencies and civil protection in the Sava River countries	high	permanent	
		1	Promotion of measures for population self-defence in case of floods	SRB	Workshop with participation of institutions responsible for emergencies and civil protection; publication in the Sava River countries' languages	high	not defined	
	M24	3	Identification/adjustment of AMIs for flood protection	SRB	Consideration of proposals and, if the required conditions are met, adoption of changes to areas of mutual importance for flood protection	high	6 years	
		3	Review and as necessary updating of PFRA in SRB	SRB	Collection of national information and preparation of a joint report	high	6 years	
		3	Exchange of relevant information in the development of national PFRAs, for international basins	SRB	Bilateral communication related to relevant data exchange	high	6 years	
		4	Upgrade of the Sava Portal in terms of presentation of national PFRA and FRMPs	SRB	Upgrade with information on dates and adoption acts in the process of preparing and adopting national PFRA and FRMP	medium	not defined	
		3	Coordination of APSFR in international basins/areas of mutual interest (AMI)	SRB	Bilateral communication in coordination of APSFR	high	6 years	
		3	Prior exchange of information in the development of flood hazard and risk maps for internationally important APSFR	SRB	Bilateral communication related to prior information exchange (complementary activities supported through Frisco 1)	high	6 years	
		3	Further development of draft joint methodologies for development of	SRB	Review and further improvement of the proposed joint methodology (complementary activities supported through Frisco 1)	high	6 years	

Aspect	Code	Objective	Measure	Measure implementation area	Indicative Description of Activities	Indicative Priority	Indicative Implementation Period	Indicative Financing Sources
			flood hazard and risk maps for AMIs					
		3	Development of flood hazard and risks maps as potential bases for joint projects and analyses	TB watercourses	Bilateral/trilateral projects supported by ISRBC in finding the financial sources	high	6 years	
		3	Preparation of the hydrological study for the SRB	SRB	Study preparation with coordination of PEG FP and HM EG (complementary activities supported through Frisco 1)	high	3 years	
		3	Preparation of a spatial layer for cultural heritage for the entire basin	SRB	Project to be coordinated by PEG FP	high	2 years	
		1	Promotion of best practices in emergency flood defence	SRB	Workshop on measures for emergency flood defence with dykes, with examples of best practices; a manual in Sava River countries' languages	high	3 years	
		1	Drafting a guide for dyke status assessment	SRB	Workshop on methodologies for the status assessment; manual in Sava River countries' languages	medium	not defined	
Protection	M31	1	Promotion of measures for natural water retention	SRB	Workshop on measures for natural retentions; publication in Sava River countries' languages	high	3 years	- European Union funds (financial instruments / funds) - Crossborder cooperation funds - National funds of the countries - International financial institutions - Bilateral donations and loans - Joint financial mechanisms and global funds
		1	Analysis of needs and possibilities for creating new retentions	TB watercourses	Bilateral/trilateral projects supported by ISRBC in finding the financial sources	as needed	3 years	
		3	Creating synergies with the Sediment Management Plan in SRB	SRB	Workshop on correlation of measures for flood risk management and measures for sediment management	high	6 years	
		1	Promotion of best practices in managing multipurpose accumulations	SRB	Workshop on best European practices, with participation of reservoir operators and users; publication in Sava River countries' languages	medium	not defined	
		1	Integrated Transboundary Monitoring and Management Systems for Flood Risks, Environmental and Biodiversity Protection and Forestry Through	AMI HR_BA_RS_ Sava (Spacva-Morovic)	Establishment of joint water, forest and environmental databases, joint monitoring, preparation of a common hydrological and hydraulic model, study for management of forest resources, joint biodiversity study, and other activities.	high	2.5 years	- Crossborder cooperation program IPA Croatia – Serbia 2014 – 2020 - "Hrvatske vode" - WWF Adria

Aspect	Code	Objective	Measure	Measure implementation area	Indicative Description of Activities	Indicative Priority	Indicative Implementation Period	Indicative Financing Sources
			Transboundary Forest Retentions and Other Measures (FORRET)					- "Vode Vojvodine" - "Vojvodinašume"
	M35	1	Drafting a guide for application of the best solutions in the protection against floods	SRB	Workshop on examples of best solutions in the protection against floods; publication in Sava River countries' languages	medium	not defined	- European Union funds (financial instruments / funds) - Crossborder cooperation funds - National funds of the countries - International financial institutions - Bilateral donations and loans - Joint financial mechanisms and global funds
		3	Studies for optimal measures for protection against floods, in accordance with the best practices (assessment of validity and concept update of the existing systems)	TB watercourses	Bilateral/trilateral projects supported by ISRBC in finding the financial sources	As needed	not defined	
		1	Analysis of the effects of accumulations and reservoirs on downstream transboundary areas in the Sava River Basin	TB watercourses	Preparation of studies with evaluation of current status and effects (positive and negative) of accumulations and reservoirs on downstream transboundary areas in the Sava River Basin	high	3 years	
		4	Monitoring and control of riverbeds for high waters	TB watercourses	Regular surveys of riverbeds and coastal zone with verification by state institutions competent for geodetic surveys	high	long-term	
		4	Regular monitoring, analysing and reporting on the state of structures and flood defence systems	TB watercourses	Proposal for preparing guidelines for improving maintenance of water protection structures	high	long-term	
		4	Drafting and regular updating of maps with overview of facilities in flood defence systems	TB watercourses	GIS database with structures, description of their state, names and contact details of competent authorities/persons	high	long-term	
Preparedness	M41	2	Continuous improvement of the system for hydrological and meteorological observations and data transfer systems	SRB	Support from ISRBC PEG for hydrometeorological matters	high	long-term	- European Union funds (financial instruments / funds) - Crossborder cooperation funds - National funds of the countries - International financial institutions - Bilateral donations and loans
		2	Improvement of national forecast and early warning systems	TB watercourses	Maintenance of FFWS, upgrades and improvements Permanent activities on data collection and development of models. Upgrades in sense of flexible model management which will be adjusted to current and long-term needs of the countries (complementary activities supported through Frisco 1)	high	long-term	

Aspect	Code	Objective	Measure	Measure implementation area	Indicative Description of Activities	Indicative Priority	Indicative Implementation Period	Indicative Financing Sources
		3	Support to linkages between national forecast and early warning systems	TB watercourses	To be implemented with the above measure	high	long-term	- Joint financial mechanisms and global funds
		3	Supporting development of joint protection and rescue plans in flood events	TB watercourses	Organisation of a roundtable event	high	long-term	
		3	Support to preparing and updating Standard Operational Procedures (SOP) between the countries that do not have them	TB watercourses	Organisation of a roundtable event	medium	not defined	
		3	Support to procedures for mutual notifying about hazards, manners of border crossing, mutual information and data exchange about hazards of occurrence and occurrence of natural and other disasters in border zones, etc.	SRB	Organisation of a roundtable event	high	not defined	
		3	Based on best practices, support development of unified procedures for actions in case of floods at the basin level in order to improve response to support actions or development of plans in case of floods at the basin level	SRB	Organisation of a roundtable event	high	not defined	
		3	Support establishment of operational centres with a comprehensive overview of contacts for mutual communication of parties within SOPs, and regular updating thereof in order to ensure efficient functioning of the notification and warning system	SRB	Organisation of a roundtable event	high	not defined	
		3	Supporting joint simulation exercises of response in flood events	TB watercourses	Organisation of a workshop	medium	not defined	

Aspect	Code	Objective	Measure	Measure implementation area	Indicative Description of Activities	Indicative Priority	Indicative Implementation Period	Indicative Financing Sources
	M43	4	Encouraging interested public to take part in implementation of FRMP in SRB	SRB	Regular communication and reporting (*Savski vjesnik*)	high	continuous	
		3, 5	Support to raising public awareness on issues relevant for flood risk management and active flood defence	SRB	Organisation of a roundtable event (complementary activities supported through Frisco 1)	high	continuous	
		4	Support to improving cooperation and activities during emergency situations	SRB	Promotion and organisation of national and regional technical multi-stakeholder round tables for planning the civil protection actions in emergencies with the aim of clarifying procedures, responsibilities and means at disposal of all relevant bodies (public and private).	low	not defined	
	M44	3	Support to establishing bilateral cooperation between countries that have no agreements in place	SRB	Organisation of a workshop	high	immediate	
		4	Information exchange and coordination of activities in operational flood defence	SRB	Creation of an internet application for information exchange between stakeholders involved in emergency flood defence, as well as for informing the public	high	continuous	
		3	Support to drafting joint plans for protection and rescue in flood events	TB watercourses	Organisation of a roundtable event	high	continuous	
	M53	4	Documenting and post flood event analysis	TB watercourses / SRB	Regular reports on significant flood events on the territory of two or more countries Preparation of a study / guide for data and information collection during flood events	high	continuous	

Mainly non-structural measures
Mainly relevant for structural measures
Measures for improved water retention in the basin

Table 22: Summary of national structural measures in areas of mutual interest

River	AMI	Country (no. of projects)	Type	Objective	Measure	Indicative Description of Activities	Promoter / Competent Institution	Indicative Financing Sources
Sava	RS_Sava	RS (9)	M33	1	City of Belgrade water protection (*Zaštita od voda grada Beograda*)	Reconstruction and superelevation of Belgrade riverbanks, mobile system	PWMC Srbijavode	- National sources (budget, the Water Fund...) - EU funds – IPA program 2014-2020 - EU crossborder programs - Loans (The World Bank, EIB...) - WBIF
			M33	1	Reconstruction of Ada Ciganlija embankement (*Rekonstrukcija nasipa na Adi Ciganliji*)	Dyke works (2+150 - 2+400)	PWMC Srbijavode	
			M33	1	Protection from high waters for left Sava bank area from Prodgar to Hrtkovci (*Zaštita od visokih voda područja na levoj obali Save od Progara do Hrtkovaca*)	Construction of an dyke near Kupinovo (0+000 to 8+300)	PWMC Vode Vojvodine	
			M33	1	Protection from high waters for left Sava bank area from Prodgar to Hrtkovci (*Zaštita od visokih voda područja na levoj obali Save od Progara do Hrtkovaca*)	Dyke reconstruction near Klenka 3.8 km	PWMC Vode Vojvodine	
			M33	1	Protection of urban area of Sremska Mitrovica and Mačvanska Mitrovica (*Zaštita gradskog područja Sremske Mitrovice i Mačvanske Mitrovice*)	Mobile protection	PWMC Vode Vojvodine and LSGs	
			M33	1	Protection of urban area of Šabac (*Zaštita gradskog područja Šapca*)	Mobile protection	PWMC Srbijavode and LSGs	
			M33	1	Stabilization of left Sava bank (*Stabilizacija leve obale Save*)	Works on stabilisation of Sava left bank in the settlement of Martinci, 2 km long	PWMC Vode Vojvodine	

River	AMI	Country (no. of projects)	Type	Objective	Measure	Indicative Description of Activities	Promoter / Competent Institution	Indicative Financing Sources
			M32	1	Protection of the City of Belgrade – regulation of Topčiderska reka basin (*Zaštita područja grada Beograda - uređenje sliva Topčiderske reke*)	Works on regulating Topčiderska reka basin with construction of small dams, reservoirs and retentions in the basin	PWMC Srbijavode	
			M33	1	Reconstruction of right Sava bank protection system in Mačva (*Rekonstrukcija sistema za zaštitu na desnoj obali Save u Mačvi*)	Reconstruction works 31 km in lenght	PWMC Srbijavode , RWD, LSGs	
	HR_BA_ Sava	HR (3)	M33	1	Construction of Slavonski Brod flood protection system (*Izgradnja sustava zaštite od poplava grada Slavonskog Broda*)	Rehabilitation of the Sava left bank in Slavonski Brod by constructing riverbank protection structures from km 363 +100 to km 363 +700 in order to stabilise the bank	Hrvatske vode	- National sources (budgets, water fees, source income of Hrvatske vode) - EU funds – Operational program „Competitiveness and cohesion 2014 - 2020" - EU crossborder cooperation programs - CEB development loan for flood protection projects - Loans (The World Bank, EIB...)
			M33	1	Construction of Slavonski Brod flood protection system (*Izgradnja sustava zaštite od poplava grada Slavonskog Broda*)	Construction of floodgate and pumping station on the course of Glogova, and reconstruction of related section of the Sava protective dyke in the zone of Brod port	Hrvatske vode	
			M33	1	Reconstruction and construction of Sava dykes and rehabilitation of riverbanks (*Rekonstrukcija i izgradnja savskih nasipa i sanacija oštećenih obala*)	Reconstruction of left-bank Sava protective dyke from Oprisavca to Svilaja, 5 km long	Hrvatske vode	
						Reconstruction of the left-side dyke Davor-Pričšac from km 6 +250 to km 15 +550 2	Hrvatske vode	
						Rehabilitation works on landslide on the left Sava bank in the village of Štitar by constructing a riverbank protection structure, rkm 275+770 to rkm 276+277 in order to stabilise the bank	Hrvatske vode	

River	AMI	Country (no. of projects)	Type	Objective	Measure	Indicative Description of Activities	Promoter / Competent Institution	Indicative Financing Sources
						Reconstruction of left bank Sava dyke in Davor km 22+500 - km 23+800 with construction of a protective wall	Hrvatske vode	
						Rehabilitation of the Sava left bank by constructing a riverbank protection structure on the section from rkm 498+961 to rkm 499+761 in the settlement of Mlaka in order to stabilise the bank	Hrvatske vode	
		BA (4)	M33	1	Construction works on rehabilitation and level raising of dykes *(Radovi na rehabilitaciji nasipa i podizanju nivoa nasipa)*	Raising the Sava River dykes level near Semberija, Bijeljina	PI Vode Srpske	- National sources (budget) - EU funds – IPA program 2014-2020 - Loans (The World Bank, EIB...) - WBIF
						Rehabilitation of dyke on Sava River near pumping station Topolovac, Bijeljina	PI Vode Srpske	
			M33	1	Works on channel cleaning (*Radovi – čišćenje kanala*)	Cleaning of Sava River lateral channels, Gradiška (1)	PI Vode Srpske	
						Cleaning of Sava River lateral channels, Gradiška (2)	PI Vode Srpske	
						Cleaning of Sava River lateral channels, Srbac (1)	PI Vode Srpske	
						Cleaning of Sava River lateral channels, Srbac (2)	PI Vode Srpske	
			M33	1	Works on dyke rehabilitation (*Radovi na sanaciji nasipa*)	Rehabilitation of Sava River dyke, Gradiška	PI Vode Srpske	
			M33	1	Works on pumping station rehabilitation and upgrade (*Radovi na sanaciji i nadogradnji crpne stanice*)	Repair and upgrade of pumping station on the Sava River, Srbac	PI Vode Srpske	

River	AMI	Country (no. of projects)	Type	Objective	Measure	Indicative Description of Activities	Promoter / Competent Institution	Indicative Financing Sources
	HR_BA_ RS_Sava	HR (1)	M33	1	Construction of drainage infrastructure Bidj-Bosutsko polje (*Izgradnja objekata odvodnje Bid - Bosutskog polja*)	Construction of pumping station Teča on the Sava near Račinovci	Hrvatske vode	- National sources (budgets, water fees, source income of Hrvatske vode) - EU funds – Operational program „Competitiveness and cohesion 2014 - 2020" - EU crossborder cooperation programs - CEB development loan for flood protection projects - Loans (The World Bank, EIB...)
Sutla	HR_SI_ Sutla_1	SI (1)	M33	1	Waterflow improvement measures (1) (*U7a - Ukrepi za povečanje pretočnosti*)	Works on improving flood protection of Rigonc and Dobova	MOESP, DRSV	- National funds - Climate fund - EU cohesion funds 2014-2020 - INTERREG macro-regional programs 2014-2020 - INTERREG V-A bilateral programs 2014-2020 - Loans (The World Bank, EIB...)
	HR_SI_ Sutla_3	SI (1)	M33	1	Waterflow improvement measures (2) (*U7a - Ukrepi za povečanje pretočnosti*)	Works on improving flood protection of Rogatac	MOESP, DRSV	
		SI/HR (1)	M32	1	Flood protection Vonarje (*Zaštita od poplava Vonarje*)	Modernization and upgrade of Vonarje dam (Frisco 2.1)	MOESP, DRSV, Hrvatske vode	- INTERREG V-A 2014-2020
		HR (1)	M33	1	Flood protection for Hum settlement on Sutla (*Zaštita od plavljenja naselja Hum na Sutli*)	River flow regulation of the Sutla river in the section of 900 m near Hum on the Sutla, with the removal of old and construction of new bridge with the aim of protecting the settlement centre from flooding	Hrvatske vode	- National sources (budgets, water fees, source income of Hrvatske vode) - EU funds – Operational program „Competitiveness and cohesion 2014 - 2020" - EU crossborder cooperation programs - CEB development loan for flood protection projects - Loans (The World Bank, EIB...)

River	AMI	Country (no. of projects)	Type	Objective	Measure	Indicative Description of Activities	Promoter / Competent Institution	Indicative Financing Sources
Kupa	HR_SI_ Kupa_2	HR (1)	M32	2	Flood protection of Čabar town (*Zaštita od poplava grada Čabra*)	Kupa – multi-purpose reservoir (flood protection and other)	Hrvatske vode	- National sources (budgets, water fees, source income of Hrvatske vode) - EU funds – Operational program „Competitiveness and cohesion 2014 - 2020" - EU crossborder cooperation programs - CEB development loan for flood protection projects - Loans (The World Bank, EIB...)
Una	HR_BA_ Una_Sana	BA (1)	M33	2	1) Riverbank protection, Dubička Ravan (*Zaštita obale rijeke, Dubička Ravan*) 2) Dyke level raising, section Kozarska Dubica, Kozarska Dubica / Bjeljina (*Podizanje nivoa nasipa, dionica Kozarska Dubica, Kozarska Dubica/Bijeljina*)	Construction works	PI Vode Srpske	- National sources (budget) - EU funds – IPA program 2014-2020 - Loans (The World Bank, EIB...) - WBIF - EU crossborder cooperation programs
		HR (2)	M33	2	Constuction of flood protection system for Hrvatska Kostajnica town (1) (*Izgradnja sustava zaštite od poplava grada Hrvatske Kostajnice*)	Construction of a protecting wall and riverbank protection structure on the left bank of the River Una in Hrvatska Kostajnica – phase 1	Hrvatske vode	- National sources (budgets, water fees, source income of Hrvatske vode) - EU funds – Operational program „Competitiveness and cohesion 2014 - 2020" - EU crossborder cooperation programs - CEB development loan for flood protection projects - Loans (The World Bank, EIB...)
			M33	2	Constuction of flood protection system for Hrvatska Kostajnica town (2) (*Izgradnja sustava zaštite od poplava grada Hrvatske Kostajnice*)	Construction of a protecting wall and riverbank protection structure on the left bank of the River Una in Hrvatska Kostajnica – phase 2	Hrvatske vode	
Sana	HR_BA_ Una_Sana	BA (1)	M33	2	Dyke on west bank of Sana River, across the centre of Prijedor (*Nasip na zapadnoj obali rijeke Sane,*	Construction works	PI Vode Srpske	- National sources - EU funds – IPA program 2014-2020 - Loans (The World Bank, EIB...)

River	AMI	Country (no. of projects)	Type	Objective	Measure	Indicative Description of Activities	Promoter / Competent Institution	Indicative Financing Sources
					nasuprot središtu Prijedora)			- WBIF
Drina	BA_RS_ Drina	BA/RS (1)	M33	1	Reconstruction of protection system on River Drina right bank (*Rekonstrukcija sustava za zaštitu na desnoj obali rijeke Drine*)	Reconstruction works	PWMC Srbijavode, RWD, LSGs	- National sources (budget, the Water Fund...) - EU funds – IPA program 2014-2020 - Loans (The World Bank, EIB...) - WBIF
		RS (2)	M33	1	Protection of Mačva-Drina and tributaries area (1) (*Zaštita područja Mačva-Drina i pritoke*)	Protection of area „Mačva, Lozničko Polje and Loznica - Banja Koviljača: Drina": Construction and reconstruction of dykes on the right bank of Drina, from Pavlovića bridge to Banja Koviljača	PWMC Srbijavode	
			M33	1	Protection of Mačva-Drina and tributaries area (2) (*Zaštita područja Mačva-Drina i pritoke*)	Protection of area „Kozjak - Jelav - Straža - Gornji Dobrić: Jadar and Korenita": Flood protection system in the area of the Loznica town – river regulation	PWMC Srbijavode	
Tara	ME_Tara	ME (1)	M33	1	River flow regulation and construction of dykes of River Tara within area of Mojkovac municipality (*Uređenje korita i nasipa rijeke Tare u području općine Mojkovac (MNES117)*)	Implementation of works	The Water Administration	- National sources (budgets, income from various types of fees) - EU funds – IPA program 2014-2020 - Loans (The World Bank, EIB...) - WBIF
Ćehotina	ME_ Cehotina	ME (1)	M33	1	Regulation of River Cehotina on section Ševari-Židovici (*Uređenje rijeke Ćehotine na dionici Ševari – Židovići (MNES110)*)	Implementation of works	The Water Administration	- National sources (budgets, income from various types of fees) - EU funds – IPA program 2014-2020 - Loans (The World Bank, EIB...) - WBIF
Lim	ME_Lim	ME (1)	M33	1	River flow regulation and construction of dykes of River Lim on Zaton section (*Uređenje korita i nasipa*	Implementation of works	The Water Administration	- National sources (budgets, income from various types of fees)

River	AMI	Country (no. of projects)	Type	Objective	Measure	Indicative Description of Activities	Promoter / Competent Institution	Indicative Financing Sources
					rijeke Lim na dionici Zaton (MNES112))			- EU funds – IPA program 2014-2020 - Loans (The World Bank, EIB...) - WBIF
Bosut	HR_RS_ Bosut	HR (1)	M33	1	Construction of drainage infrastructure Bidj-Bosutsko polje (*Izgradnja objekata odvodnje Bid - Bosutskog polja*)	Reconstruction of channel S-11 (Marikovo 1) and other ones along the international road border crossing point Bajakovo	Hrvatske vode	- National sources (budgets, water fees, source income of Hrvatske vode) - EU funds – Operational program „Competitiveness and cohesion 2014 - 2020" - EU crossborder cooperation programs - CEB development loan for flood protection projects - Loans (The World Bank, EIB...)
Kolubara	RS_ Kolubara	RS (5)	M32	2	Regulation of Kolubara basin – construction of 20 small retention dams in the basin (*Regulation of Kolubara Uređenje sliva Kolubare - Izgradnja 20 malih retenzionih brana na slivu*)	Construction of 20 small retention dams in the basin	PWMC Srbijavode	- National sources (budget, the Water Fund...) - EU funds – IPA program 2014-2020 - Loans (The World Bank, EIB...) - WBIF
			M33	1	Protection of Kolubara River area – lower part of the basin (*Zaštita područja Kolubare - donji deo rečnog sliva*)	A) Protected area of „Koceljeva": Construction of the Tamnava Borina system for the protection of the Koceljeva settlement B) Protected area of „Ub": Construction of the Ub-Gračica-Tamnava system for the protection of the settlement of Ub	PWMC Srbijavode	
			M33	1	Protection of Kolubara River area (*Zaštita područja Kolubare*)	Construction of the Ljig-Kačer-Dragobiljin system for the protection of the settlements of Ljig and Lajkovac and Toplica-Kolubara-Ribnica for the protection	PWMC Srbijavode	

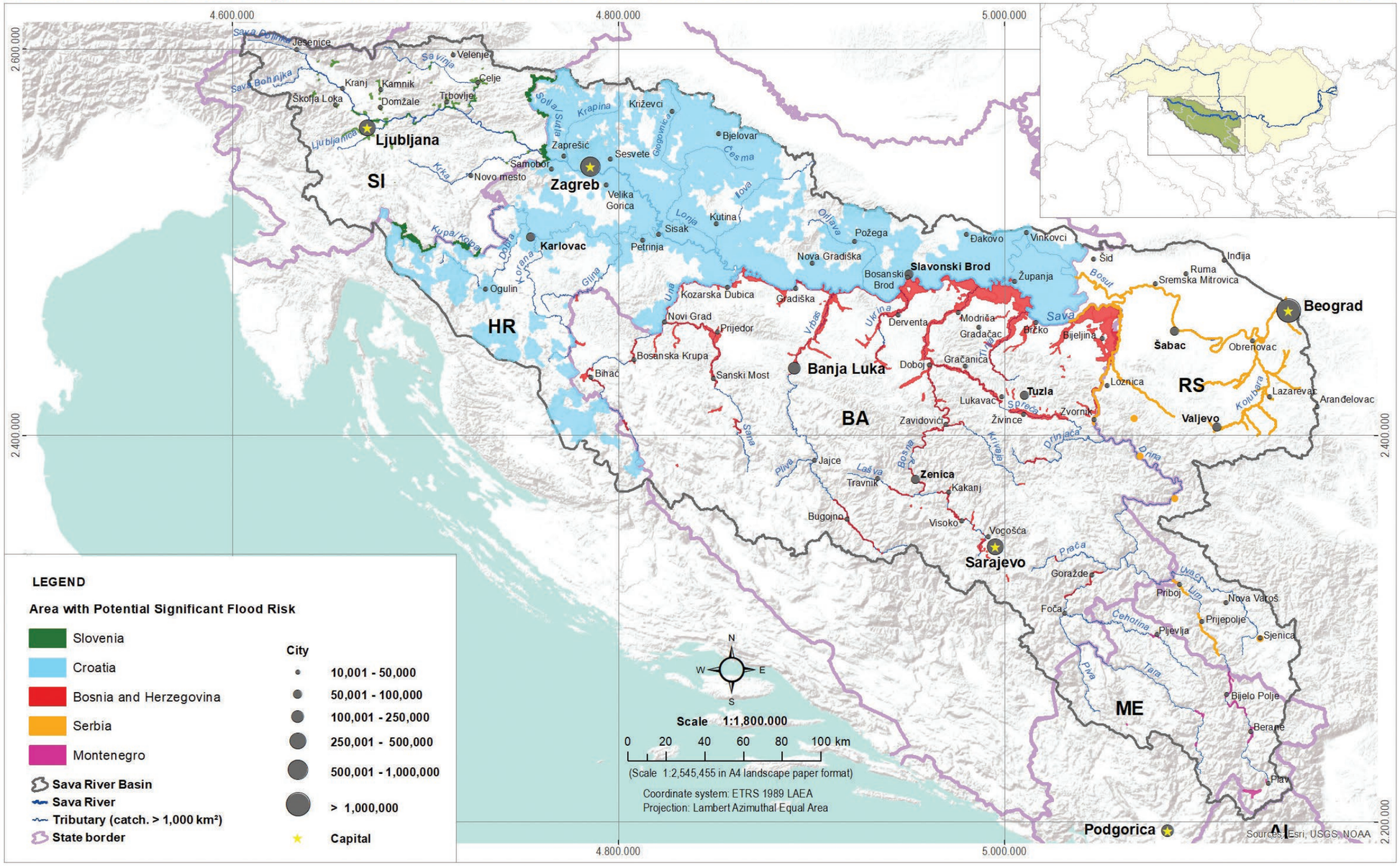
River	AMI	Country (no. of projects)	Type	Objective	Measure	Indicative Description of Activities	Promoter / Competent Institution	Indicative Financing Sources
						of the settlements of Lajkovac and Mionica against floods		
			M33	1	Protection of Valjevo area (Kolubara River and tributaries) (*Zaštita područja "Valjevo" (Kolubara i pritoke)*)	Improving the system for defence of the City of Valjevo – construction of the flood protection system on tributaries of the Kolubara River in the settlement and on the Obnica River upstream from the confluence (vulnerable area of suburbs and PI PCF Valjevo)	PWMC Srbijavode	
			M33	1	Protection of Obrenovac town (*Zaštita grada Obrenovca*)	Reconstruction of Obrenovac protection dyke	PWMC Srbijavode	- The World Bank

Annex 7
Maps

This product is based on national information provided by the Parties to the FASRB (SI, HR, BA, RS) and ME.
The borders between the countries used in preparation of FRMP for the SRB have not been finally determined.
The content and maps of FRMP do not prejudice the determination or demarcation of the borders in any way.

Project "Flood Risk Management Plan for the Sava River Basin is funded with European Western Balkans Joint Fund (EWBJF) Resources.
Processed and compiled by Eptisa Servicios de Ingeniería, 2018

Map 1: Flood events in the Sava River Basin



This product is based on national information provided by the Parties to the FASRB (SI, HR, BA, RS) and ME.
The borders between the countries used in preparation of FRMP for the SRB have not been finally determined.
The content and maps of FRMP do not prejudice the determination or demarcation of the borders in any way.

Project "Flood Risk Management Plan for the Sava River Basin is funded with European Western Balkans Joint Fund (EWBJF) Resources.
Processed and compiled by Eptisa Servicios de Ingeniería, 2018

Map 2: APSFRs in the Sava River Basin

Map 3: Areas of Mutual Interest for flood protection in the Sava River Basin (AMI)

International Sava River Basin Commission
Kneza Branimira 29/II
10000 Zagreb, Republic of Croatia
tel: +385 1 4886960
fax: +385 1 4886986
e-mail: isrbc@savacommission.org