Sava River Basin Management Plan

Background paper No.1

Surface water bodies in the Sava River Basin

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1. Introduction

This background paper gives information on description of the rivers in the Sava River Basin, the process of surface water bodies (SWBs) delineation, assessment of surface water monitoring network including proposal for achievement of compliance with WFD and methodologies applied for surface water body status assessment.

2. Description of the Sava River and its main tributaries

The Sava River rises from the Sava Dolinka and the Sava Bohinjka in Slovenia. With its numerous tributaries along 945 km waterway to the Danube, it represents one of the most significant basins in the region (basin area of 97,713.20 km^2 – SRBA Report, 2009). Together with its longer headwater, the Sava Dolinka River, the length of the river is 990 km.

Confluence of the Sava River into the Danube is in Belgrade (1,170 rkm of the Danube). Its average discharge at the confluence (Belgrade, Serbia) is about 1,700 m^3/s which results in the long-term average unit-area-runoff for the complete catchment of about 18 l/s/km^2.

The most important tributaries are listed in Table 1.

Based on the SRBA Report (2009), it was agreed that the rivers with drainage area above 1,000 km^2 will be taken into account as well as reservoirs with a volume above 5 million m^3. Next to the above mentioned rivers, three smaller rivers (Sotla/Sutla, Lašva, Tinja) of the basin-wide importance were included in the Sava RBMP.

The detail hydrological features are described in SRBA Report (2009). In general, the upper part of the basin is characterized by torrential tributaries – Kkra, Kamniška Bistrica and Savinja (from the left side) and Sora, Ljubljanica and Krka (from the right). East of Ljubljana, the Sava flows through a 90 km long gorge and afterwards through the Karst Plain (Krško polje). In its middle and lower stretch, the Sava River flows through wide floodplain.

Common feature of almost all right tributaries of the Sava River is their torrential character, particularly in their upper sections. River channels are often deeply cut into the hard rocks, with very violent flow through gorges.

The Bosna, Una and Vrbas Rivers are, by the size of catchment area, as well as the length, among the most important tributaries.

Table 1: List of the rivers in the Sava River Basin considered for the Sava RBMP

River name	River basin size (km²)	River length (km)	Sava RB countries sharing the river basin	Tributary order	Confluence to the Sava/tributary L-left side R-right side
Sava	97,713.2	944.7	SI, HR, BA, ME RS	-	-
Ljubljanica	1,860.0	40.00	SI	1st	R
Savinja	1,849.0	93.60	SI	1st	L
Krka	2,247.0	94.70	SI	1st	R
Sotla/Sutla	584.3	89.70	SI, HR	1st	L
Krapina	1,237.0	66.87	HR	1st	L
Kupa/Kolpa	10,225.6	118.3	SI, HR, BA	1st	R
Dobra	1,428.0	104.21	HR	2nd	R
Korana	2,301.5	147.62	HR, BA	2nd	R
Glina	1,427.1	112.22	HR, BA	2nd	R
Lonja	4,259.0	47.95	HR	1st	L
Česma	3,253.0	105.75	HR	2nd	L
Glogovica	1,302.0	64.48	HR	3rd	R
Ilova (Trebež)	1,796.0	104.56	HR	1st	L
Una	9,828.9	157.22	HR, BA	1st	R
Sana	4,252.7	141.10	BA	2nd	R
Vrbas	6,273.8	235.00	BA	1st	R
Pliva	1,325.7	31.45	BA	2nd	L
Orljava	1,618.0	93.44	HR	1st	L
Ukrina	1,504.0	80.9	BA	1st	R
Bosna	10,809.8	272.00	BA	1st	R
Lašva	958.1	55,20	BA	2nd	L
Krivaja	1,494.5	74.3	BA	2nd	R
Spreča	1,948.0	147.28	BA	2nd	R
Tinja	904.0	88.10	BA	1st	R
Drina	20,319.9	335.67	ME, BA, RS	1st	R
Piva	1,784.0	43.50	ME	2nd	L
Tara	2,006.0	134.20	ME, BA	2nd	R
Ćehotina	1,237.0	118.66	ME, BA	2nd	R
Prača	1,018.5	62.67	BA	2nd	L
Lim	5,967.7	278.5	AL, ME, RS, BA	2nd	R
Uvac	1,596.3	117.70	RS, BA	3rd	R
Drinjača	1,090.6	90.00	BA	2nd	L
Bosut	2,943.1	132.18	HR, RS	1st	L
Kolubara	3,638.4	86.70	RS	1st	R

The Bosna River forms the Bosna River Valley, an important industrial area. The sub-basin is populated by nearly a million inhabitants. The biggest tributaries of the Bosna River are the Željeznica, Miljacka, Fojnica, Lašva, Gostović, Krivaja, Usora, and Spreča Rivers.

The Una River flows through Croatia and Bosnia and Herzegovina and its main tributaries are the Unac, Sana, Klokot and Krušnica Rivers.

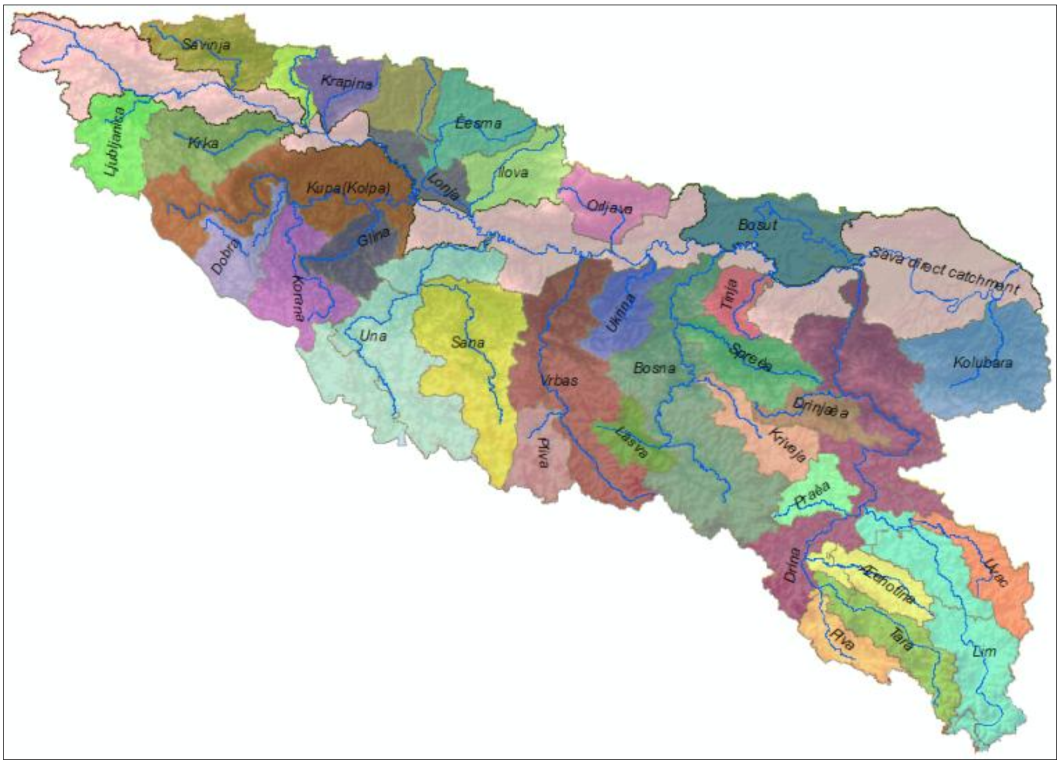
The Vrbas River originates from the southern slope of the Vranica Mountain (near the town Gornji Vakuf, approximately 1,530 meters above the sea level). The river drains central part of the northern slopes of the Dinaric Mountains. Confluence of the Vrbas River into the Sava River is at around 90 meters above the sea level (Municipality of Srbac). The most important tributaries of the Vrbas River are the Pliva, Ugar, Vrbanja and Crna Rijeka Rivers.

The Drina River is the largest tributary of the Sava River. Its drainage basin extends into four countries: Montenegro, Bosnia and Herzegovina, Serbia and a small part of Albania. The river course is formed in Montenegro after merge of two mountainous streams (rivers Tara and Piva that drain very rugged mountains of northern part of Montenegro). In its further course it receives several tributaries: Sutjeska, Prača and Drinjača (from the left) and the Ćehotina, Lim, Rzav, Ljubovija and Jadar (from the right). The Lim River is the most important tributary of the Drina River.

The left tributaries, except in the upper part of the catchment (in Slovenia), flow mostly over lowland areas of the Pannonian Basin, which determine the character of the watercourses – generally temperate slope reduced water velocity in comparison to the right hand tributaries. The most important left tributaries are Sutla/Sotla (SI and HR), Krapina, Lonja, Ilova and Orljava (HR), and Bosut (HR and RS). These rivers encompass much smaller part of the drainage than the right tributaries, thus making the Sava River catchment asymmetric.

The location of the selected sub-basin of basin wide importance is presented in Figure 1.

Figure 1: Sava River sub-basins (with catchment areas larger than 1,000 km²)



2.1 Sectioning of the River Sava

As proposed by the WFD, a proper typology has to be established based on the principal natural characteristics of water types. This is an important activity that serves as the basis for assessment of the ecological status and effective water management. The identification of river types, as relatively homogeneous hydrological and geological systems, implies the existence of linked biological communities.

The classification is especially complex in the case of typology of large lowland rivers, such as the Sava River, since those rivers absorbs a catchment's characteristics and different influences along the considerable stretch.

In order to provide proper typology, the general sectioning of the large lowland rivers should be considered.

In this chapter is provided a short discussion on sectioning of the Sava River on the main geomorphologic reaches. General characteristics, such as relief, ecoregions, terrain slope, dominant bottom substrate and dominant geological substrate were taken into the consideration.

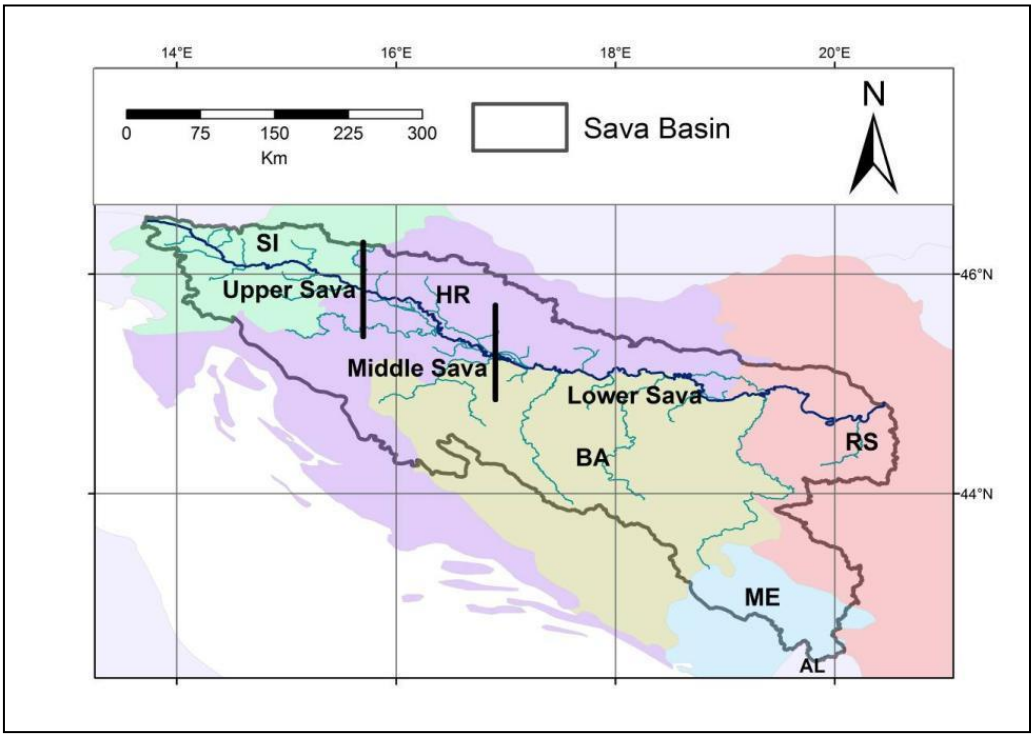
Based on the analyses of available data, the Sava River could be divided into three geomorphologic units.

The upper stretch of the Sava River flows through hilly mountain region of Slovenia. The approximate boundary between upper and middle stretch of the river is Slovenian-Croatian border.

The same border could be confirmed by ecoregion change – the area is the zone of transition of ecoregion 05 – Dinaric western Balkan to ecoregion 11 – Hungarian lowlands (see Figure 2).
The Upper Sava course (upper reach or upper geomorphologic unit) is characterized by a steep slope, by torrential tributaries and domination of coarse fractions in bottom substrate. The hilly mountain terrain dominates. The reach is 265 km long (together with the Sava Dolinka, longer headwater). The region is characterized by diverse environmental conditions and consequently a complex bio-geographic feature, which is illustrated by division to ecoregions (Figure 2). Three ecoregions are shared within a narrow area of ecoregions 4, 5 and 11. The division of the River Sava to three general geomorphologic reaches is illustrated in Figure 3.

Figure 2: Ecoregions within the Sava River Basin.

Figure 3: Sectioning of the Sava River



The Middle Sava is characterized by a moderate slope and it flows through lowland landscape. The pebbles and gravel dominate in the bottom substrate in the majority of the stretch. It is the shortest geomorphologic unit (129 km long), situated within the ecoregion 11 (Pannonia Plain).

Further, general changes in bottom characteristics determine the border between the Middle and the Lower Sava River. According to available data, the gravel dominates down to the Una confluence and Sisak. Thus, the confluence of the Una River is proposed as the border between the Middle and Lower Sava.

The Lower Sava is the longest (597 km) geomorphologic unit. This section of the Sava River is a typical lowland watercourse: it is located within the plain area, with ca. 0.098 ‰ declination, the river channel is wide up to 1,000 m and with relatively thick depositions dominated by small fractions of sand and silt. The long-term average water discharge at Sremska Mitrovica (about 100 km upstream the mouth) is close to 1.500 $m^3 s^{-1}$.

The sectioning of the Sava River should be further elaborated primarily based on the data on dominant bottom type. A certain discrepancies between available data have been recorded (e.g. river type description within the Middle and a part of the Lower Sava shared by Bosnia and Herzegovina and Croatia).

3. Delineation of surface water bodies

3.1 Introduction

"Body of surface water" means a discrete and significant element of surface water such as a lake, a reservoir, a stream, river or canal, part of a stream, river or canal, a transitional water or a stretch of coastal water.

Water body is the basic unit that is used for reporting and assessing compliance with the Water Framework Directive's environmental objectives.

The identification of water bodies is based on geographical and hydrological parameter. However, the identification and subsequent classification of water body must provide for a sufficiently accurate description of this defined geographic area to enable an unambiguous comparison to objectives of the Water Framework Directive. This is because the environmental objectives of the WFD, and the measures needed to achieve them, apply to water body. A key descriptor is the "status" of water body itself.

Heavily modified water bodies may be identified and designated where good ecological status is not being achieved because of impacts on the hydro-morphologic characteristics of the surface water resulting from physical alterations.

A discrete element of surface water should not contain significant elements of different status. A "water body" must be capable of being assigned to a single ecological status class with sufficient confidence and precision through the WFD's monitoring programmes.

WFD sets out two systems for delineation water bodies into types - System A and system B. Only the system A typology specifies values for size descriptors for rivers and lakes. The application of system B must achieve, at least, the same level of differentiation as system A.

3.2 Water bodies delineation

Based on analyses of WBs within the Sava River Basin reported by the Sava RB countries (available templates, data connected to shape files, various documents, reports), water bodies delineation have been done for all Sava River Basin rivers larger than 1000 km^2.

Following activities have already been accomplished regarding surface water body harmonisation:

- ✓ Analysis of surface water bodies (WBs) based on the Sava River Basin Analysis Report[1];
- ✓ Selection of the WBs with catchment area larger than 1000 km^2;
- ✓ In addition basin importance rivers (Sotla/Sutla, Lašva, Tinja) the water bodies have been also identified;
- ✓ Merging of Sava river WBs and WBs at its tributaries according to the hydrological order;
- ✓ Identification of problems of some WBs within individual countries;
- ✓ Analysis of related documents with regards to the Water bodies and Typology;
- ✓ Update of WBs by countries:
    - Republika Srpska updated WBs on the Sava River;
    - Federation of Bosna and Herzegovina updated WBs on most of the rivers;
    - Slovenia updated typology;
    - Croatia updated WBs;
    - Proposal of the WBs for Montenegro.

In total, 189 surface water bodies have been delineated by the Sava RB countries. Some of them (44) are shared water bodies. Out of these, 126 are natural rivers and 63 heavily modified or candidates for heavily modified WBs (see Table 2). Distribution of the WBs in the Sava RB countries is illustrated on Figure 4.

Total number of water bodies of the Sava River and its tributaries is different due to the fact that not all trans-boundary water bodies have been harmonized.

Table 2: List of delineated surface water bodies

Name of river	Water body code	Length (km)	Natural Water Body	HMWB (x/c-Candidate)
SAVA	SI111VT5	23.73	x	
SAVA	SI111VT7	10.73		x
SAVA	SI1VT137	25.2	x	
SAVA	SI1VT150	9.4	x	
SAVA	SI1VT170	13		x
SAVA	SI1VT310	22.1	x	
Ljubljanica	SI14VT77	23.1	x	
Ljubljanica	SI14VT93	4.6		x
Ljubljanica	SI14VT97	12.3	x	
SAVA	SI1VT519	25.7	x	
SAVA	SI1VT557	31.2	x	
Savinja	SI16VT17	44.6	x	
Savinja	SI16VT70	24.5	x	
Savinja	SI16VT97	24.5	x	
SAVA	SI1VT713	17.2		x

[1] http://www.savacommission.org/

Name of river	Water body code	Length (km)	Natural Water Body	HMWB (x/c-Candidate)
SAVA	SI1VT739	17	x	
SAVA	SI1VT913	21.6	x	
SAVA	SI1VT930	3.7	x	
Krka	SI18VT31	29.3	x	
Krka	SI18VT77	26.1	x	
Krka	SI18VT97	39.3	x	
Sotla/Sutla	SI192VT1	31.1	x	
	DSRI190002	11.27		c
	DSRI190003	21.74	x	
Sotla/Sutla	SI192VT5	58.60	x	
	DSRI190001	55.11	x	
Krapina	DSRN180003	22.35	x	
Krapina	DSRN180002	15.39		c
Krapina	DSRN180001	22.13		c
SAVA	DSRI010010	4.64	x	
SAVA	DSRN010009	9.48	x	
SAVA	DSRN010008	41.09		c
SAVA	DSRN010007	66.47		c
SAVA	DSRN010006	51.03		c
Kupa/Kolpa	SI21VT13	21.3	x	
	DSRI020003	19.86	x	
Kupa/Kolpa	SI21VT50	103.34	x	
	DSRI020004	85	x	
Kupa/Kolpa	SI21VT70	12	x	
Kupa/Kolpa	DSRN020002	10.54	x	
Kupa/Kolpa	DSRN020001	28.68	x	
Kupa/Kolpa	DSRN935009	133.41	x	
Dobra	DSRN420001	44.47	x	
Dobra	DSRN340001	29.12	x	
Dobra	DSRN020001	22.86	x	
Korana	DSRI330004	23.36	x	
	BA_KOR_1	23.36	x	
Korana	DSRN330003	45.25	x	
Korana	DSRN330002	24.37	x	
Korana	DSRN330001	26.93	x	
Glina	DSRN320006	7.98	x	

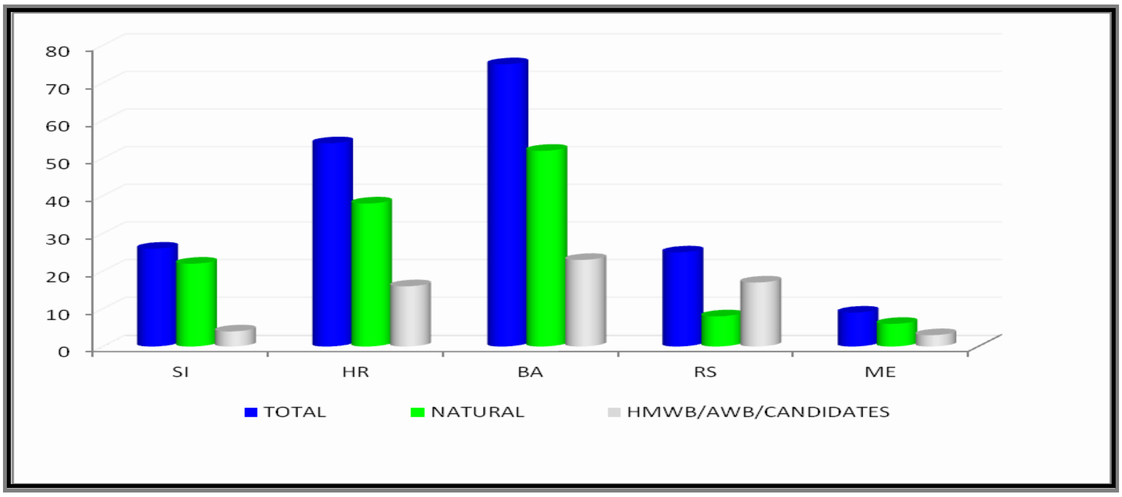
Name of river	Water body code	Length (km)	Natural Water Body	HMWB (x/c-Candidate)
Glina	DSRN320005	20.11	x	
Glina	DSRN320004	2.55	x	
Glina	DSRI320003	27.94	x	
Glina	DSRN320002	26.85	x	
Glina	DSRN320001	26.88	x	
SAVA	DSRN010005	25.56		c
SAVA	DSRI010004	89.00		c
	BA_SA_3	89.00	x	
Ilova	DSRN155046	4.52	x	
Ilova	DSRN155020	31.61		c
Ilova	DSRN150001	43.39		c
Una	BA_UNA_4	12.00	x	
	DSRI030004	15.26	x	
Una	BA_UNA_3	55.70	x	
	DSRI030003	35.91	x	
Una	BA_UNA_2	57.34	x	
	DSRI030002	12.92	x	
Una	BA_UNA_1	70.54	x	
	DSRI030001	70.87	x	
Sana	BA_UNA_SAN_5	16.50	x	
Sana	BA_UNA_SAN_4	35.8	x	
Sana	BA_UNA_SAN_3	17.8	x	
Sana	BA_UNA_SAN_2	36.4	x	
Sana	BA_UNA_SAN_1	34.68	x	
Lonja	DSRN160001	33.73	x	
Česma	DSRN165051	32.78	x	
Česma	DSRN165034	21.05		c
Česma	DSRN165011	26.83		c
Glogovnica	DSRN165080	24.00	x	
Glogovnica	DSRN165042	25.75	x	
Vrbas	BA_VRB_8	12	x	
Vrbas	BA_VRB_7	51	x	
Vrbas	BA_VRB_6	27	x	
Vrbas	BA_VRB_5	17		x
Vrbas	BA_VRB_4	18		x
Vrbas	BA_VRB_3	26.79		x

Name of river	Water body code	Length (km)	Natural Water Body	HMWB (x/c-Candidate)
Vrbas	BA_VRB_2	17.27	x	
Vrbas	BA_VRB_1	73.68		x
Pliva	BA_VRB_PLIVA_4	9.78	x	
Pliva	BA_VRB_PLIVA_3	11.96	x	
Pliva	BA_VRB_PLIVA_2	6.81		x
Pliva	BA_VRB_PLIVA_1	2.9	x	
Orliava	DSRN130003	6.79	x	
Orliava	DSRN130002	37.32	x	
Orliava	DSRN130001	31.01	x	
SAVA	DSRI010003	50.48		c
	BA_SA_2	89.75		c
SAVA	DSRI010002	62.72		c
SAVA	DSRI010001	105.33		c
	BA_SA_1	141.00		c
SAVA	RS_SA_3	34.08		c
Ukrina	BA_UKR_2	17.74	x	
Ukrina	BA_UKR_1	63.16	x	
Bosna	BA_BOS_7	7	x	
Bosna	BA_BOS_6	22.7	x	
Bosna	BA_BOS_5	48.2	x	
Bosna	BA_BOS_4	34.5	x	
Bosna	BA_BOS_3	36.9	x	
Bosna	BA_BOS_2	46.4	x	
Bosna	BA_BOS_1	79.63	x	
Lašva	BA_BOS_LAS_5	2.1	x	
Lašva	BA_BOS_LAS_4	22.3	x	
Lašva	BA_BOS_LAS_3	11.7	x	
Lašva	BA_BOS_LAS_2	8.8	x	
Lašva	BA_BOS_LAS_1	10.3	x	
Tinja	BA_SA_TIN_4	25.2	x	
Tinja	BA_SA_TIN_3	18.6	x	
Tinja	BA_SA_TIN_2	20.6	x	
Tinja	BA_SA_TIN_1	23.7	x	
Krivaja	BA_BOS_KRI_4	4.7	x	
Krivaja	BA_BOS_KRI_3	7.4	x	
Krivaja	BA_BOS_KRI_2	59	x	

Name of river	Water body code	Length (km)	Natural Water Body	HMWB (x/c-Candidate)
Krivaja	BA_BOS_KRI_1	3.82	x	
Spreča	BA_BOS_SPR_4	11.53	x	
Spreča	BA_BOS_SPR_3	50.3	x	
Spreča	BA_BOS_SPR_2	6.6		x
Spreča	BA_BOS_SPR_1	73.1	x	
Bosut	DSRN110005	14.27	x	
Bosut	DSRN110004	10.92	x	
Bosut	DSRN110003	47.31	x	
Bosut	DSRI110002	22.19	x	
	DSRI110001	7.83	x	
	RS_BOS	38		x
Drina	BA_DR_7	21.08	x	
Drina	BA_DR_6	27.5		c
Drina	BA_DR_5	42.5		x
Drina	BA_DR_4	56.8		x
	RS_DR_4	56.8		x
Drina	BA_DR_3	79.5		x
	RS_DR_3	79.5		x
Drina	BA_DR_2	29		x
	RS_DR_2	29		x
Drina	BA_DR_1	91		x
	RS_DR_1	91		x
Piva	ME_PIV_2	34	x	
Piva	ME_PIV_1	9.5	x	
Tara	ME_TAR_2	109.76	x	
Tara	ME_TAR_1	24.44	x	
	BA_DR_TAR_1	24.44	x	
Ćehotina	ME_CECH_3	27.5	x	
Ćehotina	ME_CECH_2	10.5	x	
Ćehotina	ME_CECH_1	55	x	
Ćehotina	BA_DR_CECH_1	25.66	x	
Prača	BA_DR_PRA_5	13.76	x	
Prača	BA_DR_PRA_4	18.35	x	
Prača	BA_DR_PRA_3	12.55	x	
Prača	BA_DR_PRA_2	3.33	x	
Prača	BA_DR_PRA_1	14.68	x	

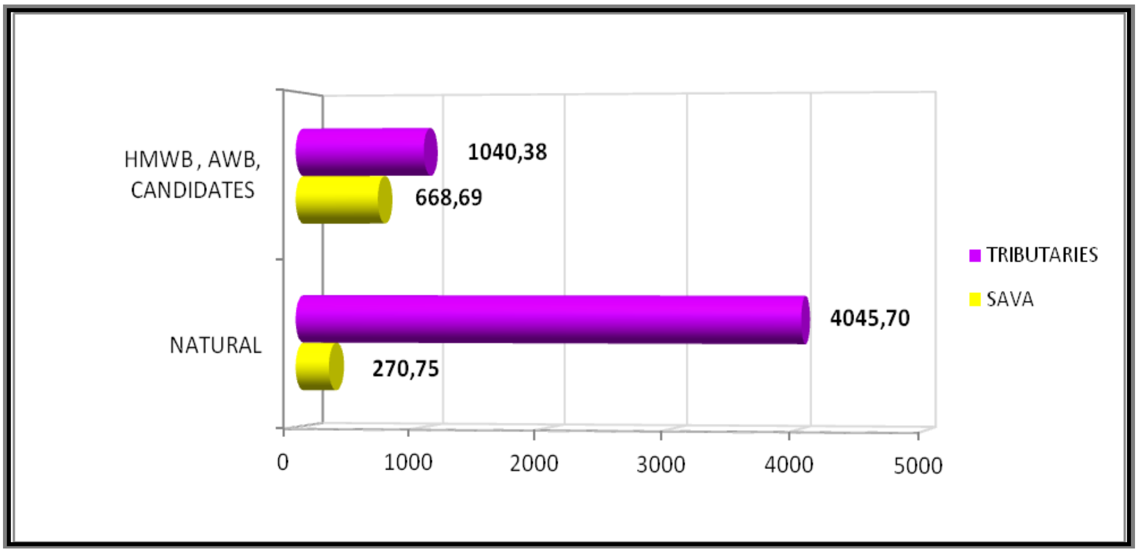
Name of river	Water body code	Length (km)	Natural Water Body	HMWB (x/c-Candidate)
Lim	ME_LIM_1	42	x	
Lim	ME_LIM_2	43.5	x	
Lim	RS_LIM_4	82	x	
Lim	RS_LIM_3	40		x
Lim	RS_LIM_2	26.23	x	
Lim	RS_LIM_1	44.77	x	
	BA_LIM_1	44.77	x	
Uvac	RS_UV_7	21.8	x	
Uvac	RS_UV_6	22		x
Uvac	RS_UV_5	18.1		x
Uvac	RS_UV_4	12		x
Uvac	RS_UV_3	8.3	x	
Uvac	RS_UV_2	27.33	x	
Uvac	RS_UV_1	8.17	x	
	BA_DR_LIM_UVA_1	8.17	x	
Drinjača	BA_DRNJ_7	3.4	x	
Drinjača	BA_DRNJ_6	17.2	x	
Drinjača	BA_DRNJ_5	10.8	x	
Drinjača	BA_DRNJ_4	13.31	x	
Drinjača	BA_DRNJ_3	33.5	x	
Drinjača	BA_DRNJ_2	7.5	x	
Drinjača	BA_DRNJ_1	4.29	x	
SAVA	RS_SA_2	77	x	
SAVA	RS_SA_1	102		x
Kolubara	RS_KOL_6	5.2		x
Kolubara	RS_KOL_5	7.1	x	
Kolubara	RS_KOL_4	24.6	x	
Kolubara	RS_KOL_3	25.6		x
Kolubara	RS_KOL_2	11.2	x	
Kolubara	RS_KOL_1	13		x

Figure 4: Number of all delineated surface water bodies in the Sava River Basin per country



From the total number of delineated WBs on the Sava River (25), 11 WBs were reported as natural, 5 WBs have been designated as HMWBs and 9 WBs are candidates for HMWB. The number of natural delineated WBs on the tributaries is 130, 24 WBs tributaries have been identified as HMWBs and 10 WBs are candidates for HMWB/AWB.

Figure 5: The length (in km) of the delineated natural WBs, HMWBs and candidates for HMWB/AWBs for the Sava River and its tributaries



The stated total length of the Sava River and its tributaries (Figure 6) is different from the real length due to problems with the harmonisation of trans-boundary water bodies. The lengths of all delineated WBs were counted if different lengths of WBs on trans-boundary stretches were reported by the neighbouring countries.

Table 3: The share and area of the Sava River Basin per country; length and number of delineated WBs for Sava River Basin rivers with catchment areas >1000 km² (including Sotla/Sutla, Lašva, Tinja)

Country	Share of national territory in the Sava RB (%)	Area of the country in the Sava RB (km²)	Length of national Sava RB river network (km)*	Number of water bodies (WB) in the Sava RB
SI	52.8	11,734.8	675.20	26
HR	45.2	25,373.5	1,816.21	55
BA	75.8	38,349.1	2, 273.13	74
RS	17.4	15,147.0	904.78	25
ME	49.6	6,929.8	356.20	9

**Represents all delineated WBs*

Several differences regarding the borders of delineated trans-boundary WBs have been recorded for certain sections of the main course of the Sava River and its tributaries shared by neighbouring countries. Details are given in the Annex 1.

In the trans-boundary section the number of WBs are different in case of Sotla/Sutla (Slovenia has delineated one WB, while Croatia two WBs) and Bosut (Croatia delineated two WBs, while Serbia only one WB).

The length of the WBs is not harmonized in case of Sotla/Sutla River (two WBs on the border between Slovenia and Croatia), Kupa/Kolpa River (two WBs on the border between Slovenia and Croatia), Una River (four WBs on the border between Bosnia and Herzegovina and Croatia) and Sava (two WBs on the border between Croatia and Bosnia and Herzegovina).

This water bodies should be harmonized in line with WFD on bilateral level (e.g. in the frame o trans-boundary commissions).

4. Surface water monitoring network in the Sava River Basin

4.1 Introduction

According to the WFD, the establishment of the monitoring programmes of water status in order to establish a coherent and comprehensive overview of water status within each river basin district, have to be realized.

For surface waters monitoring programmes shall cover the ecological and chemical status and ecological potential. The surveillance, operational and investigative monitoring should be established.

The parameters, which are indicative for the status of each relevant quality element have to be monitored. In selecting parameters for biological quality elements, the identification of the appropriate taxonomic level is required to achieve adequate confidence and precision in the classification of the quality elements. Estimates of the level of confidence and precision of the results provided by the monitoring programmes shall be given in the plan.

4.2 Assessment of the existing national and Danube basin wide monitoring networks

Slovenia

Slovenia as a Member State established their monitoring programme in line with principles of the WFD, described in the national RBMP. Surveillance and operational monitoring are currently running covering most of relevant quality elements and frequencies. Environmental Agency of Slovenia is responsible body for data collection.

Croatia

In Croatia the water quality monitoring network is operated primarily by Croatian Waters. The whole monitoring system has been revised to be in line with the requirements of the WFD. The Operational monitoring has not been in operation in Croatia yet, however, it was possible to provide information on quality elements in OM on the basis of the document "Regulation on water quality standards" (Official Gazette No. 153/2009).

Bosnia and Herzegovina

Monitoring on water quality and quantity in rivers in Federation of Bosnia and Herzegovina exists, but is not in accordance with the WFD. Monitoring program is, mostly, organized at the same monitoring sites as before 1992.

In 2009 were monitored 42 physico-chemical and four microbiological quality elements on 47 sites in the Sava RB. Two biological quality elements (phytobenthos and benthic in-vertebrates) were monitored on 33 sites. Frequencies of monitoring of physico - chemical quality elements were three times/year, biological quality elements were monitored two times per year. On some sites, 34 organic toxic substances are monitored (OCP, VOC, PAH, OPP, triazines and urea pesticides). In 2009 the quantitative monitoring was organised twice (May and July) at the same time as monitoring of quality parameters.

The existing monitoring sites in Federation of Bosnia and Herzegovina cannot be at present assigned as sites of operational and surveillance monitoring. The reference monitoring programme is under construction.

According to the Water Law (Office gazette FBA, No 70/06) organisation of the hydrological and quality monitoring and monitoring of the ecological status in the Sava RB in FBA is the task and obligation of the Sava River Watershed Agency Sarajevo.

In the Republic of Srpska, as one of the entities in Bosnia and Herzegovina (approx. 48% of the total territory), the surface water quality monitoring (including water level and flow, where possible) has been performed by Ministry of Agriculture, Forestry and Water Management of the Republic of Srpska and Water Agency for Sava River District since the year of 2000. In 2007, surface water monitoring network was revised with the main goal to meet the WFD compliant monitoring requirements as much as possible. For rivers with catchment area >1,000 km^2, the monitoring network consists of the following elements:

- Surveillance monitoring I: Monitoring of surface water status-rivers (SM 1, nine sites);
- Surveillance monitoring II: Monitoring of specific pressures; (TNMN monitoring stations, SM 2, nine sites)
- Operational monitoring (OM, 22 sites).

Within SM 2 the list of parameters for assessment of trends and their monitoring frequencies (annually/12 x per year), is the same as a joint monitoring activity of all ICPDR Contracting Parties, which produces data on concentrations of selected parameters in the Danube and major tributaries.

Serbia

Republic Hydrometeorological Service of Serbia has been running systematic monitoring of quantity and quality of both surface and groundwater. Up to 2010, the monitoring has been carried out in accordance with the Law on Waters (Official Gazette of the Republic of Serbia No. 46/91, 53/93, 67/93 and 48/94) and the Act on the systematic surface and ground water quality monitoring adopted by the Government of the Republic of Serbia. Since the new Law on Water was accepted by the Serbian Parliament (15th of May 2010 – "Official Gazette of the Republic of Serbia" no. 30/2010), the conditions for gradual adaptation of monitoring system to WFD requirements have been created. The Water Law regulates water protection, protection from the harmful effects of water and water use. The Law applies to surface and groundwater, including drinking water, thermal and mineral water.

In the next two years, according to the Water Law, water quality and water management by-laws and the issues of the financial investments and tariffs will be subject of the work of the Ministry of Agriculture, Forestry and Water Management – Directorate for Water. A set of by-laws will cover the water status monitoring methodology, and will provide system compliant with WFD principles. The Republic Directorate for Water is responsible for the conception and implementation of an integrated national policy, including the policy of international cooperation.

Up to now, the subdivision of monitoring network to SM 1, SM 2 and OM was not performed, except in the case of TNMN reporting network. In addition, a preliminary proposal for subdivision of monitoring stations has been prepared for the Kolubara River Basin (part of the SRB), as a pilot area for WFD implementation.

Systematic water regime monitoring with simultaneous assessment of the water quantity and quality provides a reliable data on state of the water resources as the basis for water resources management, flood protection and water pollution control.

In accordance to surface and groundwater flow regime, a network of monitoring stations has been established and monitoring programme has been set aiming to assess condition of waters in space and time, in Serbia. The main objective of setting the qualitative monitoring system was obtaining the large amount of data which have been further gathered in the RHMS database. They have been published annually in RHMS Annual Reports – separately for data on surface waters, groundwater and water quality.

The monitoring network and parameters covered at each station is defined by the Annual Monitoring Programme.

The network encompasses 147 monitoring stations at rivers and channels in the whole territory of Serbia. The assessment started in the 1960s with approximately 55 stations and has been enlarged mainly until the 1990s to the present number. Within the last ten years there have not been major changes to the network design, except introduction of 15 additional monitoring sites at the Kolubara River Basin (interim and supplementary interim monitoring). Therefore, for the majority of stations long-term series of data are available.

The monitoring stations are generally subdivided into i) main stations, ii) primary stations and iii) secondary stations. At each monitoring station assigned to the mentioned categories i), ii) or iii), there are hydrological gauging stations in operation for the frequent survey of water levels and discharges. Monitoring stations without any classification do not dispose of hydrological gauging stations. If applicable, the discharge is assessed in parallel while sampling the other parameters.

National surface water monitoring is carried out on 129 profiles at 73 watercourses on a monthly basis, 24 times a year on state border profiles and main monitoring locations.

Montenegro

Surface water quality monitoring in Montenegro is performed in a traditional way not taking into account requirements of the WFD. It is operated by the Hydro-meteorological institute of Montenegro in Podgorica. The parameters and frequencies are focused mostly on the protection of the drinking water abstraction areas.

4.3 Danube Transnational Monitoring Network

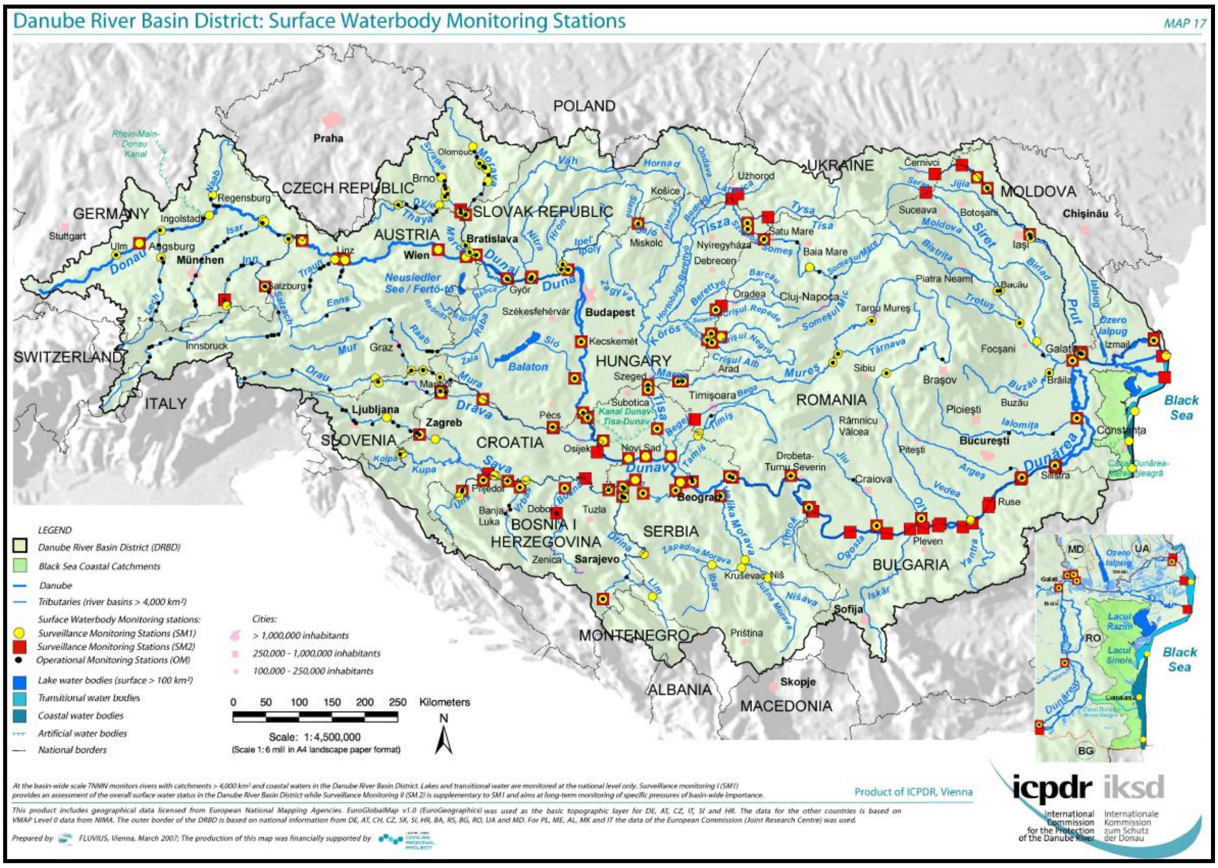
The provisions of the Danube River Protection Convention include the need for cooperation in the field of monitoring and assessment, which is accomplished through the operation of the Trans National Monitoring Network (TNMN) in the Danube River Basin. The TNMN has been in the operation since 1996 but the first steps towards it were taken ten years earlier under the Bucharest Declaration, when a monitoring programme was established containing 11 trans-boundary cross sections on the Danube River.

The original objective of the TNMN was to strengthen the existing network set up by the Bucharest Declaration, to enable a reliable and consistent trend analysis for concentrations and loads of priority pollutants, to support the assessment of water quality for water use and to assist in the identification of major pollution sources.

In 2000, having the experience of the TNMN operation, the main objective of the TNMN was reformulated: to provide a structured and well balanced overall view of the status and long-term development of quality and loads in terms of relevant constituents in the major rivers of the Danube Basin in an international context.

The TNMN laboratories have a free choice of an analytical method, providing they are able to demonstrate that the method in use meets the required performance criteria. Therefore, the minimum concentrations expected and the tolerance required for actual measurements have been defined for each determinant so that the method compliance can be checked. To ensure the quality of collected data a basin-wide AQC programme is regularly organized by the ICPDR.

Figure 6: Surface water monitoring stations in the Danube River Basin District



During first ten years of its operation TNMN network comprised over 75 water quality monitoring stations and more than 50 chemical, biological and microbiological parameters were investigated. Ten years of TNMN operation provided an excellent overview of the water quality in the Danube River Basin. It gave decision-makers data to make the right policy and investment decisions to improve water quality.

Implementation of the WFD after 2000 necessitated the revision of the TNMN in the Danube River Basin District. In line with the WFD implementation timeline, a revised TNMN has been under operation since 2007 (Figure 6).

The major objective of the revised TNMN is to provide an overview of the overall status and long-term changes of surface water and – where necessary – groundwater status in a basin-wide context with a particular attention paid to the trans-boundary pollution load. In view of the link between the nutrient loads of the Danube and the eutrophication of the Black Sea, it is necessary to monitor the sources and pathways of nutrients in the Danube River Basin District and the effects of measures taken to reduce the nutrient loads into the Black Sea.

To meet the requirements of both the WFD and the Danube River Protection Convention the revised TNMN for surface waters consists of following elements:

- Surveillance monitoring I (SM 1): Monitoring of surface water status
- Surveillance monitoring II (SM 2): Monitoring of specific pressures
- Operational monitoring (OM)
- Investigative monitoring

Overview of monitoring sites used for the surveillance monitoring 1 and 2 and for the operational monitoring in the Sava River Basin is in Figure 7.

Figure 7: Stations for the different types of monitoring of surface water

4.4 Comparability of monitoring results

4.4.1 Analytical methodologies

The analytical methodologies for the determinants applied in the TNMN are based on a list containing reference and optional analytical methods. The National Reference Laboratories (NRLs) have been provided with a set of ISO standards (reference methods) reflecting the determinant lists, but taking into account the current practice in environmental analytical methodology in the EU it has been decided not to require each laboratory to use the same method, providing the laboratory would be able to demonstrate that the method in use meets the required performance criteria. Therefore, the minimum concentrations expected and the tolerance required for actual measurements have been defined for each determinant, in order to enable laboratories to determine whether the analytical methods currently in use are acceptable.

To ensure the quality of the TNMN data an inter-laboratory comparison exercise has been organized regularly each year since 1992. At present, the National Reference Laboratories and other national laboratories taking part in the monitoring activities of the TNMN participate in the QualcoDanube proficiency testing organized by VITUKI in Hungary. Within this exercise all monitored determinants are covered by three quarterly test sample distributions while the fourth distribution is dedicated to those determinants which showed more than 30 % flagged results.

Analytical methods of the National Reference Laboratories and other national laboratories taking part in the monitoring activities have to apply also the Directive 2009/90/EC laying down, pursuant to Directive 2000/60/EC of the European

Parliament and of the Council, technical specifications for chemical analysis and monitoring of water status.

4.4.2 Distribution of the performance testing check samples

The quarterly distribution of the check samples is as follows:

- During the 1st, 2nd and 3rd quarter of the year, water samples and/or synthetic concentrates will be distributed, two concentration levels (surface water) for each determinant (N.B.: to ensure evaluation of the results the Youden-pair method is used). The determinants for the three distributions are selected in such a way that ensures the full coverage, at least once, of the determinants on the TNMN determinant lists.
- Sediment samples are distributed during the 2nd and 3rd quarter.
- Based on the results obtained during the 1st, 2nd and 3rd quarter distribution, test samples are redistributed during the 4th quarter for those determinants, which showed unacceptable results, i.e., double-flagged, at least in 15% of the participating laboratories.

The determinants for the 4th quarter distribution are identified on the basis of the evaluation, interpretation of the results of the 1st, 2nd and 3rd quarters.

4.4.3 Determinants

Each determinant is "intercalibrated" at least once during each year.

Although the distribution programme can be slightly modified (due to practical reasons) the following distribution pattern is usually applied:

During the 1st distribution:

- General parameters, nutrients, aggregate parameters, e.g. COD, TOC, AOX, detergents, etc., in synthetic concentrates, surface water;

During the 2nd distribution:

- Heavy metals, petroleum hydrocarbons in synthetic concentrates, surface water;
- Total-N, Total-P and heavy metals in sediment;

During the 3rd distribution:

- Trace organic pollutants in synthetic concentrates, surface water;
- Trace organic pollutants, i.e., chlorinated hydrocarbons, PAHs, in sediment; samples of macrozoobenthos (benthic invertebrates);

During the 4th distribution:

- Specified according to the approach described in section 6.1.2.

4.4.4 Evaluation of the performance testing

As it is expected that each TNMN determinant is analysed once in a distribution during the 1st, 2nd or 3rd quarter, therefore it is important that the results are evaluated at the end of each distribution and the results are communicated to the laboratories.

Information on the determinants for the 4th distribution is provided after evaluation of the results of the 3rd distribution. At the end of the yearly distributions, an Annual AQC Report is prepared.

4.5 Monitoring of hazardous substances in the Sava River during Joint Danube Surveys

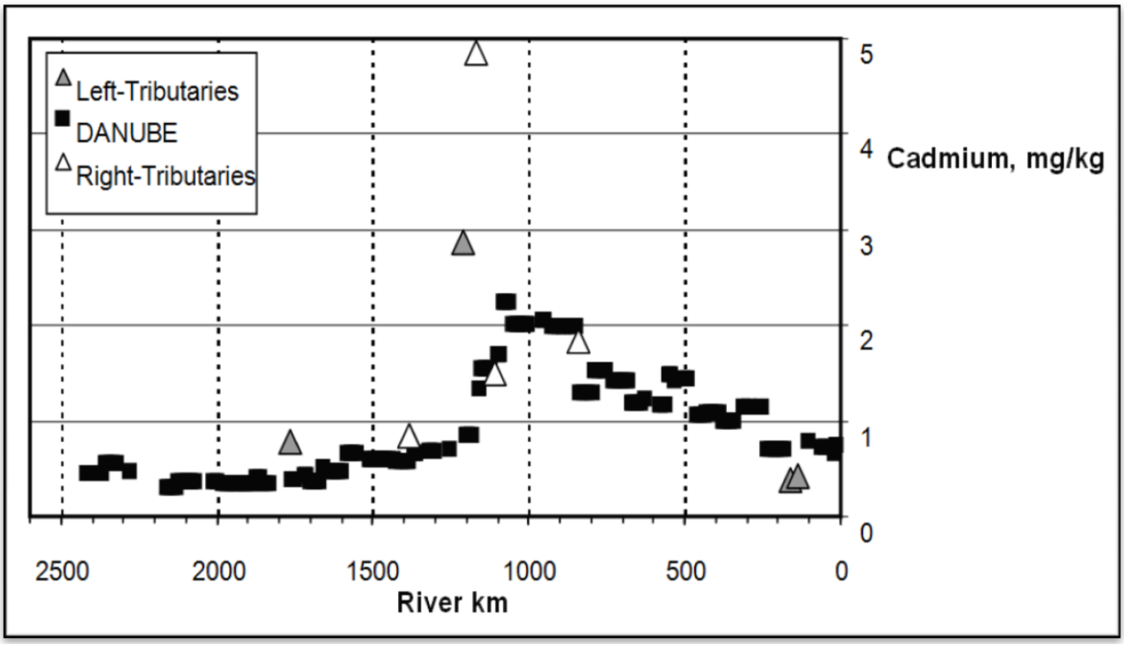
The occurrence of hazardous substances in the Sava River was explored during Joint Danube Surveys organized by the ICPDR. A large number of organic substances with wide range of polarity including priority substances and other substances such as pesticides, pharmaceuticals and endocrine disrupters as well as heavy metals were monitored in water, sediment, suspended solids and biota.

One of the key findings of JDS1 (Joint Danube Survey), which took place in 2001, was that the highest concentration value of atrazine (0,78 µg/L) which was detected during the survey was found in the Sava River. This elevated concentration even had an influence on the Danube water downstream the confluence with Sava to the Irongate reservoir (JDS65 = Golubac/Koronin).

The results of JDS2 carried out in 2007 brought more comprehensive information on the occurrence of organic micropollutants and heavy metals in the Sava River. The Sava along with the Tisza Rivers was found to supply the Danube with increased amounts of Cd, Pb, Ni, Cr and Zn in the suspended solids.

As an example, Figure 8 clearly demonstrates the significant impact of the Tisza and Sava Rivers on the lower Danube, through an elevated concentration of cadmium in the suspended solids. The 1.2 mg/kg standard level was significantly exceeded in both rivers and their impact on the Danube SPM was apparent along a 1,000 km Danube reach downstream of confluence with the Sava River.

Figure 8: Distribution of Cadmium in the SPM along the Danube River during JDS2



A clear impact of the Sava River was observed in results from the analyses of mussel samples. Cadmium values in the Danube itself fluctuated from 0.17 to 11.8 mg/kg; however, the highest concentration was measured in the Sava River (29.6 mg/kg). Lead showed differences in the Danube mussels from 0.63 to 10.9 mg/kg, with the highest value again in the Sava (14.6 mg/kg). Concentration of chromium varied from 0.21 to 8.63 mg/kg in the Danube, with nearly the same concentration in its tributary Sava (8.47 mg/kg). In general, out of the surveyed tributaries, most of the highest concentrations of heavy metals were measured in the Sava River. Thus, the results of the JDS2 showed that accumulation of heavy metals in the Sava River is of concern and should be further explored.

As regards organic substances, JDS2 results showed that di-(2-ethylhexyl)phthalate (DEHP) exceeded environmental quality standard for priority substances in water in the mouth of the Sava River. Significant DEHP-concentration was found also in the suspended particulate matter from the Sava (5,03 mg/kg). Detailed investigation of emerging substances brought evidence on occurrence of a number of compounds (see Table 2) which should be a subject of future research.

Table 2: a/b Water concentrations of organic substances determined in the Sava River during the JDS2 (in ng/L)

a)

No.	River, Location	Nap-roxen	Bent-azone	Keto-profen	Meco-prop	Ibu-profen	Gem-fibrozil	PFOA	PFOS	Caff-eine
SA1	Sava, Zupanja	2	6		2	5	3	2	7	139
SA2	Sava, Jamena	2	4		2	5	3	2	7	176
SA3	Sava, Sremska Mitrovica		2	31		5	1	1	5	146
SA4	Sava, Ušće	4	5			10	2	2	5	141

b)

No.	River, location	Desethyl-atrazine	Carba-mazepine	Sulfamethox-azole	Atra-zine	Terbutyl azine	Desethyl terbutylazine	NPE1C	Nonyl-phenol	Bis-phenol A
SA1	Sava, Županja	10	28	35	3	2	4	47		24
SA2	Sava, Jamena	11	27	46	3	4	3	46		18
SA3	Sava, Sremska Mitrovica	9	15	25	2	2	1	46	110	246
SA4	Sava, Ušće	10	18	37	2		3	55	100	

Concentrations highlighted in red colour indicate a significant environmentally relevant concentration.

4.6 Description of the WFD compliant surface monitoring programmes in the Sava River Basin

The surface water monitoring network shall be established in accordance with the requirements of Article 8 of the Water Framework Directive (WFD). The monitoring network shall be designed so as to provide a coherent and comprehensive overview of ecological and chemical status within each river basin.

On the basis of the characterisation and impact assessment carried out in accordance with Article 5 and Annex II of the WFD, for each river basin management plan period three types of monitoring programmes should be established:

- ✓ surveillance monitoring programme,
- ✓ operational monitoring programme,
- ✓ investigative monitoring programme.

All available information about chemical pressures and impacts should be used for setting up the monitoring strategy. Such information would include substance properties, pressure and impact assessments and additional information on sources.

The monitoring programmes will need to take account of variability in time and space (including depth) within a water body. Sufficient samples should be taken and analysed to adequately characterise such variability and to generate meaningful results with proper confidence. The use of numerical models with a sufficient level of confidence and precision for designing the monitoring programmes can also be helpful.

The documentation of progressive reduction in concentrations of priority substances and other pollutants, and the principle of no deterioration are key elements of WFD and require appropriate trend monitoring. This should be considering when designing monitoring programmes. Data obtained in surveillance and operational monitoring may be used for this purpose.

4.6.1 Designing of surveillance monitoring

Surveillance monitoring programmes should be established to provide information for:

- ✓ supplementing and validating the impact assessment procedure,
- ✓ the efficient and effective design of future monitoring programmes,
- ✓ the assessment of long-term changes in natural conditions,
- ✓ the assessment of long-term changes resulting from widespread anthropogenic activity.

The results of such monitoring shall be reviewed and used in combination with the impact assessment procedure described in Annex II of WFD, to determine requirement for monitoring programmes in the current and subsequent river basin management plans.

Surveillance monitoring shall carried out the sufficient surface water bodies to provide an assessment of the overall surface water status within each basin or sub basin within the river basin district. Surveillance monitoring should be carried out at representative points where:

- ✓ the rate of water flow is significant within the river basin district as a whole; including points on large rivers where the catchment area is greater than 2,500 km^2,
- ✓ the volume of water present is significant within the river basin district, including large lakes and reservoirs,
- ✓ significant bodies of water cross boundary,
- ✓ sites are identified under the Information Exchange Decision 77/795/EEC,
- ✓ sites are required to estimate the pollutant load which is transferred across boundaries.

Surveillance monitoring shall be carried out for each monitoring site for a period of one year during the period covered by a river basin management plan for:

- ✓ parameters indicative of all biological quality elements,
- ✓ parameters indicative of all hydromorphological quality elements,
- ✓ parameters indicative of all general physico-chemical quality elements,
- ✓ priority list pollutants which are discharged into the river basin or sub-basin,
- ✓ other pollutants discharged in significant quantities in the river basin or sub-basin, unless the previous surveillance monitoring exercise showed that the body concerned reached good status and there is no evidence from the review of impact of human activity, that the impacts on the body have changed (in these cases, surveillance monitoring shall be carried out once every three river basin management plans).

4.6.2 Designing of operational monitoring

Operational monitoring shall be undertaken in order to:

- ✓ establish the status of those bodies identified as being at risk of failing to meet their environmental objectives,
- ✓ assess any changes in the status of such bodies resulting from the programmes of measures.

The programme may be amended during the period of the river basin management plan in the light to allow a reduction in frequency where an impact is found not to be significant or the relevant pressure is removed.

Operational monitoring shall be carried out for all those bodies of water which on the basis of either the impact assessment or surveillance monitoring are identified as being at risk of failing to meet their environmental objectives and for those bodies of water into which priority list substances are discharged. Monitoring points shall be selected for priority list substances as specified in the legislation laying down the relevant environmental quality standard. In all other cases, including for priority list substances where no specific guidance is given in such legislation, monitoring points shall be selected as follows:

- ✓ for bodies at risk from significant point source pressures, sufficient monitoring points within each body in order to assess the magnitude and impact of the point source. Where a body is subject to a number of point source pressures monitoring points may be selected to assess the magnitude and impact of these pressures as a whole,
- ✓ for bodies at risk from significant diffuse source pressures, sufficient monitoring points within a selection of the bodies in order to assess the magnitude and impact of the diffuse source pressures. The selection of bodies shall be made such that they are representative of the relative risks of the occurrence of the diffuse source pressures, and of the relative risks of the failure to achieve good surface water status,
- ✓ for bodies at risk from significant hydromorphological pressure, sufficient monitoring points within a selection of the bodies in order to assess the magnitude and impact of the hydromorphological pressures. The selection of bodies shall be indicative of the overall impact of the hydromorphological pressure to which all the bodies are subject.

4.6.3 Designing of investigative monitoring

Investigative monitoring shall be carried out:

- ✓ where the reason for any exceedances is unknown,
- ✓ where surveillance monitoring indicates that the objectives for a body of water are not likely to be achieved and operational monitoring has not already been established, in order to ascertain the causes of a water body or water bodies failing to achieve the environmental objectives, or to ascertain the magnitude and impacts of accidental pollution.

Results of the investigative monitoring shall inform the establishment of a programme of measures for the achievement of the environmental objectives and specific measures necessary to remedy the effects of accidental pollution.

4.6.4 Frequencies of the monitoring

For the surveillance monitoring period, the frequencies for monitoring parameters indicative of physico-chemical quality elements given in table 5 should be applied unless greater intervals would be justified on the basis of technical knowledge and expert judgement.

For biological or hydromorphological quality elements monitoring shall be carried out at least once during the surveillance monitoring period.

For operational monitoring, the frequency of monitoring required for any parameter shall be determined by country so as to provide sufficient data for a reliable assessment of the status of the relevant quality element. As a guideline, monitoring should take place at intervals those shown in the table 5 unless greater intervals would be justified on the basis of technical knowledge and expert judgement.

Frequencies shall be chosen so as to achieve an acceptable level of confidence and precision. Estimates of the confidence and precision attained by the monitoring system used shall be stated in the river basin management plan.

Monitoring frequencies shall be selected which take account of the variability in parameters resulting from both natural and anthropogenic conditions. The times at which monitoring is undertaken shall be selected so as to minimise the impact of seasonal variation on the results, and thus ensure that the results reflect changes in the water body as a result of changes due to anthropogenic pressure. Additional monitoring during different seasons of the same year shall be carried out, where necessary, to achieve this objective.

Table 5: Frequencies of the monitoring

Quality element	Rivers	Lakes
Biological		
Phytoplankton	6 month	6 month
Other aquatic flora	3 years	3 years
Macro invertebrates	3 years	3 years
Fish	3 years	3 years

Quality element	Rivers	Lakes
Hydromorphological		
Continuity	6 years	
Hydrology	continuous	
Morphology	6 years	6 years
Physico-chemical		
Thermal conditions	3 months	3 months
Oxygenation	3 months	3 months
Salinity	3 months	3 months
Nutrient status	3 months	3 months
Acidification status	3 months	3 months
Other pollutants	3 months	3 months
Priority pollutants	1 month	1 month

4.6.5 Methods for monitoring

Methods for sampling, sample preparation and analysis should be preferably based on the standardized methods (ISO, EN, national).

4.6.6 Cost estimation of surveillance monitoring

Based on the experiences from the Member states from the Danube River Basin the cost estimation is given in the table 6 for one water body with one sampling site (in case of some of the biological quality element it means sampling stretch). Estimated price covers all needed costs for particular quality element.

Table 6: Cost estimation for the surveillance monitoring

Group of parameters	Parameter	Cost estimation (€)
Biological parameters	Phytoplankton	112
	Phytobenthos (benthic diatoms)	276
	Macrophytes including survey	286
	Benthic invertebrates	305
	Fish	
	A. Wadable river (up to 5 m width)	700
	B. Wadable rivers (each additional 5 m)	450
	C. Non-wadable rivers	3,000

Group of parameters	Parameter	Cost estimation (€)
Physico-chemical parameters	Temperature, pH, oxygen, alkalinity, nutrients, BOD, COD, conductivity, hardness....	100
Hydromorphological parameters	Small rivers ≤15 m width	1,600
	Middle size rivers 15 – 50 m width	2,400
	Large rivers ≥ 50 m width	4,000
Priority substances	33 priority substances and 8 other substances	1,346
Other pollutants	e.g. 4 heavy metals	50
Sampling (water)	Physico-chemical parameters, priority substances, other substances, phytoplankton	18

4.7 Proposal of general approach and the criteria for selection of monitoring sites for the SRB

Out of the three monitoring types (operational, surveillance and investigative), the surveillance monitoring results are the most important for basin wide review of the status.

Operational monitoring (OM), since it is established to evaluate the changes of water bodies quality being in risk not to achieve good ecological and/or chemical status/potential, based on the selected indicative parameters, and by analysing specific pollutants that are found to be important for particular water body, is of less importance for the general overview of the SRB status. Further, the OM sites are functional only in the case of failing to reach good chemical and/or ecological status, thus they are not constant. Thus, this document will not review in detail the OM network.

As in the case of the DRB, we propose the approach which includes additional surveillance monitoring 2 (SM2) sites.

The design of surveillance monitoring 1 (SM 1) within DRB is based on WFD Annex V, 1.3.1. The monitoring network is based on the national surveillance monitoring networks and the operating conditions are harmonized between the national and basin-wide levels to minimise the efforts and maximise the benefits. The criteria for selecting monitoring points have been modified to meet the scale of the DRB District, to be able to provide an assessment of the overall surface water status within the District.

SM 2 is designed as supplementary to SM1 with the main objective to monitoring specific pressures of basin-wide importance. The network is planned as a long-term monitoring scheme. It is, therefore, classified as pressure-specific surveillance monitoring. Selected quality elements or specific determinants should be monitored at higher frequencies than in SM1, while other quality elements should not be monitored. A denser monitoring programme is needed on specific pressures in order to allow a long-term trend assessment of specific pollutants and to achieve a effective estimation of pollutant loads being transferred. The SMS2 monitoring network within DRB is based on the national monitoring networks and the operating conditions are harmonized between the national and basin-wide levels to minimise the efforts and maximise the benefits.

The aims of SM2 are:

- Providing the data for river basin management planning on the SRB level;
- Providing the platform for effective trend analyses;
- Providing the frame for more effective status assessment on national level, since the data are available for shared stretches; and
- Providing the basis for better design of future monitoring programmes.

For the Sava RB, the SM1 sites should be considered based on the following criteria:

- Rivers with catchments of >1,000 km^2 shall have at list one surveillance monitoring site;
- Rivers <1,000 listed in the Table 7 (rivers considered as important for SRBMP, according to the agreement between the Sava countries) of the SRBMP should have one monitoring site; and
- The sites along the Sava River should be situated to enable analyses of the influence of the major tributaries and point sources of pollution to the Sava River.

In the case of SM2, the selection of sites should be based on the availability of the data from the site in the past, to enable long term analyses, as well as the following criteria:

- Located just upstream/downstream of an international border;
- Located upstream of confluences between Danube and main tributaries or main tributaries and larger sub-tributaries (to enable estimation of mass balances);
- Located downstream of the major point sources; and
- Located to control important water uses.

The basic aim of the SM2 is to provide rough data, to be used for analyses. SM1 monitoring network should provide the data on status, only.

4.8 Review of the existing TNMN monitoring set-up and proposal of a upgraded network within Sava RB

In the case of monitoring network that should be used for data exchange within SRB and that should provide the data for management planning on the basin wide level, additional criteria are needed, to be adapted to large scale of the SRB.

Thus, surveillance monitoring should be carried out on a sufficient number of surface water bodies to provide an assessment of the overall surface water status within SRB.

Comparative review of the ecological and chemical status and current TNMN monitoring network is presented at Figure 9.

According to the data uploaded to the DANUBIUS, the TNMN network within the SRB covers all together 29 OM sites, 37 SM1 and 20 SM2 sites.

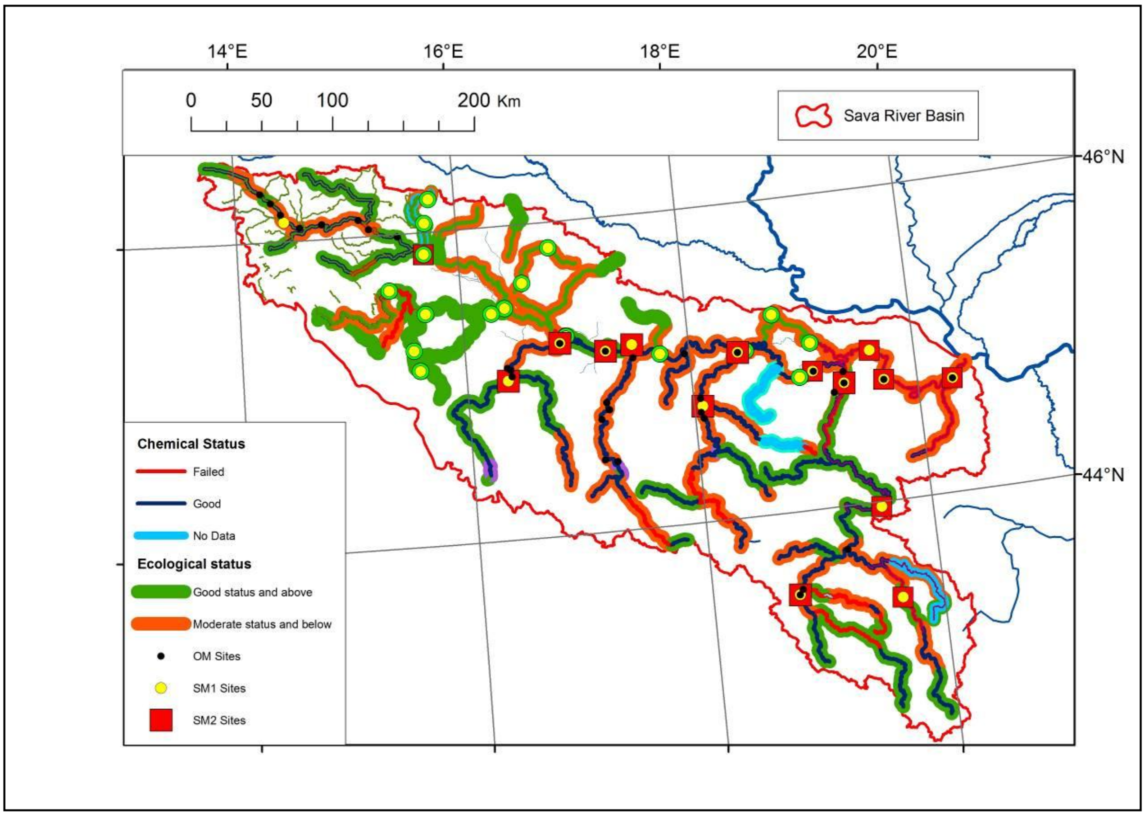
In general, the sites are well situated to provide general overview of the water status within the basin area.

From the Figure 9 it is clear that the distribution of OM sites is unequally distributed within SRB and that the distribution of those sites in not in harmonisation with status assessment provided for the SRBMP. Thus, according to the situation presented on Figure 9, some OM sites could be cancelled, if the situation stays the same (e.g. OM site Brestanica in the Slovenian part of the Sava River).

From the other side, in the next RBM cycle, the including of additional OM sites should be considered (on the Dobra, Kupa, water bodies BA_BOS 4 and 5, water bodies Ćehotina 1 and 2, BA_BOS_SPR4, RS_KOL1 and 2), if the further analyses show that the recorded pollutants are regularly find in the concentrations that could influence the status of downstream situated water bodies, and consequently are of relevance for the SRB.

From the Figure 9, it is clear that there are water bodies with currently unknown status (Sotla, Tinja, one WB on the Spreča river), as well as that some larger tributaries (first and second order) are not covered by SM1 sites (Krka, Savinja, Ljubljanica, Ilova, Tinja, Ukrina, Orljava, Kolubara, and Uvac). In addition, according to the situation after TNMN upgrade, Montenegro still didn't upload the TNMN sites to DANUBIUS.

Figure 9: Comparative review of TNMN sites and water status within SRB



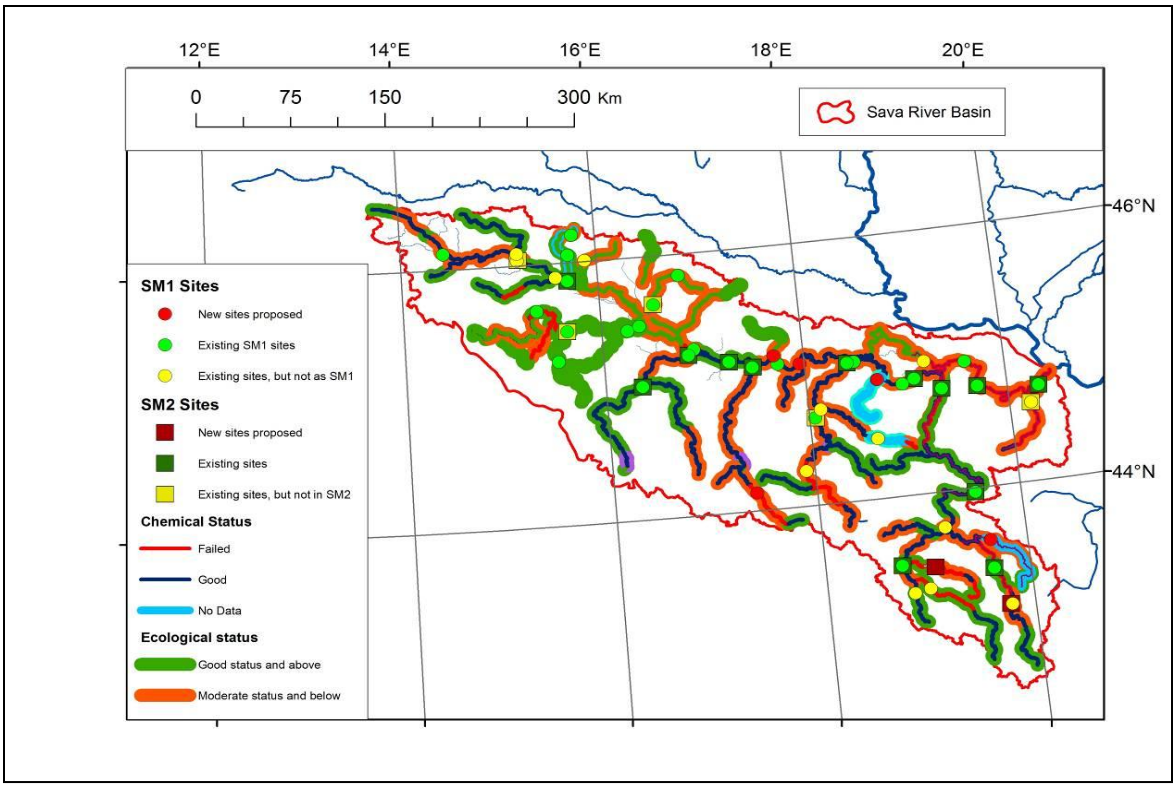
Based on the criteria presented above, as well as according to the status assessment presented at Figure 9, the proposal presented on the Figure 10 has been prepared, with 48 SM1 sites (Table 7).

Table 7: List of SM1 sites proposed for the Sava RB

Id No.	Site name	River name	Status
17	Doboj	Bosna	Existing
18	Modriča	Bosna	Existing
41	BA_BOS4	Bosna	New
42	Morović	Bosut	New
32	Narta	Česma	Existing
33	Obedište	Česma	Existing
28	Rača/Badovinci	Drina	Existing
29	Bajina Bašta	Drina	Existing

Id No.	Site name	River name	Status
30	Foča	Drina	Existing
5	Radovići (Metilka)	Kolpa	Existing
39	Draževac	Kolubara	New
10	Veljun	Korana	Existing
11	Brest	Korana	Existing
45	Krapina, lower part	Krapina	New
43	Krška Ves	Krka	New
9	Rečica	Kupa	Existing
31	Prijepolje	Lim	Existing
37	Upstream bordes, WB MELIM_2	Lim	New
48	Lim, mouth to the Drina	Lim	New
47	Orljova, lower stretch	Orljova	New
36	Lower stretch	Piva	New
1	Medno	Sava	Existing
4	Drenje, Jesenice	Sava	Existing
6	Jasenovac, upstream the Una confluence	Sava	Existing
12	Upstream the Kupa confluence and Sisak	Sava	Existing
13	Gradiška, upstream the Vrbas confluence	Sava	Existing
15	Downstream the Vrbas confluence	Sava	Existing
16	Downstream the Bosna confluence	Sava	Existing
21	Račinovci	Sava	Existing
22	Jamena	Sava	Existing
23	Vrhovo	Sava	New
24	Sr. Mitrovica	Sava	Existing
25	Šabac	Sava	Existing
26	Ostružnica	Sava	Existing
44	Veliko Sirje	Savinja	New
2	Lupinjak	Sotla	Existing
3	Zelenjak	Sotla	Existing
27	Spreča, confluence	Spreča	New
40	BA_BOS_SPR3	Spreča	New
35	Lower stretch	Tara	New
19	BA_TIN_1_New site - Tinja confluence	Tinja	New
46	Ukrina, lower stretch	Ukrina	New
7	Una, confluence to the Sava	Una	Existing
8	Una, Novi grad	Una	Existing
34	Uvac, confluence	Uvac	New
14	Razboj	Vrbas	Existing
20	BA_VRB__New site - Vrbas, upper stretch	Vrbas	New
38	Novoselje	Vrbas	New

Figure 10: SM1 and SM2 sites proposed for the Sava RB



The proposal for SM2 sites is presented in Table 8 and Figure 10.

Table 8: List of SM2 sites proposed for the SRB

Id No.	Site name	River name	Status
1	Drenje, Jesenice	Sava	Existing
2	Gradiška	Sava	Existing
3	Una, confluence	Una	Existing
4	Vrbas confluence	Vrbas	Existing
5	Modriča	Bosna	Existing
6	Jamena	Sava	Existing
7	Rača/Badovinci	Drina	Existing
8	Šabac	Sava	Existing
9	Ostružnica	Sava	Existing
10	Draževac	Kolubara	New
11	Foča	Drina	Existing
12	Bajina Bašta	Drina	Existing
13	Prijepolje	Lim	Existing
14	Lim, upstream RS/ME border	Lim	New
15	Novi grad	Una	Existing
16	Vrhovo	Sava	New
17	Rečica	Kupa	New
18	Doboj	Bosna	New
19	Obedište	Česma	New
20	MECECH_2	Ćehotina	New

Seven new sites have been proposed for the SM2 network. We are of opinion that proposed SM1 and SM2 scheme could provide the efficient base for assessment of the overall status of the water bodies within SRB and could offer valuable data for river basin management planning within the SRB.

5. Surface Water Status

5.1. Surface water status assessment methodology

5.1.1 Introduction

Surface water status is the general expression of the status of a body of surface water, determined by the poorer of its ecological and chemical status. Good surface water status means that its ecological and chemical status are at least ”good”.

Ecological status is an expression of the quality of the structure and functioning of aquatic ecosystems. Good ecological status is the status of body of surface water classified in accordance with Annex V of the Water Framework Directive (WFD). Good ecological potential is the status of heavily modified or artificial body of water. Assessment of the ecological status is focused on the main course of the river water body. Flood plain area evaluation is included in the frame of hydromorphological assessment in this planning cycle.

Ecological status classification has basic principles:

- ✓ Type specific classification,
- ✓ Selected quality elements should reflect the stress/pressure,
- ✓ Classification by used quality elements should fulfil normative definitions,
- ✓ The procedure of assessment is based on the comparison to the reference conditions.

Baseline for the assessment of the **chemical status** is the list of priority substances and certain other pollutants and the environmental quality standards given by the Directive 2008/105/EC on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council. Additionally the Directive 2009/90/EC laying down, pursuant to Directive 2000/60/EC of the European Parliament and of the Council, technical specifications for chemical analysis and monitoring of water status has to be taken into account. Chemical status has to meet the requirements of environmental objectives for surface waters outlined in the WFD Article 4(1). Good chemical status must not exceed the environmental quality standards established in line with the WFD Article 16(7), in EU Directive 2008/105/EC on environmental quality standards in the field of water policy.

5.1.2 Quality elements

Ecological classification consists of quality elements (Table 7):

- ✓ Biological quality elements,
- ✓ Physical-chemical quality elements,
- ✓ Hydro-morphological quality elements,
- ✓ Specific synthetic or non-synthetic pollutants.

Table 7: Quality elements to be used for assessment of ecological status based on the list in Annex V, 1.1 of the WFD.

Annex V 1.1.1. RIVERS	Annex V 1.1.2. LAKES
Biological elements	
• *Composition and abundance of aquatic flora*[11] • *Composition and abundance of benthic invertebrate fauna* • *Composition, abundance and age structure of fish fauna*	• *Composition, abundance and biomass of phytoplankton* • *Composition and abundance of other aquatic flora* • *Composition and abundance of benthic invertebrate fauna* • *Composition, abundance and age structure of fish fauna*
Hydromorphological elements supporting the biological elements	
• *Quantity and dynamics of water flow* • *Connection to ground water bodies* • *River continuity* • *River depth and width variation* • *Structure and substrate of the river bed* • *Structure of the riparian zone*	• *Quantity and dynamics of water flow* • *Residence time* • *Connection to the ground water body* • *Lake depth variation* • *Quantity, structure and substrate of the lake bed* • *Structure of the lake shore*
Chemical and physicochemical elements supporting the biological elements	

• *Thermal conditions*
• *Oxygenation conditions*
• *Salinity*
• *Acidification status*
• *Nutrient conditions*
• *Specific pollutants*
  • *pollution by priority substances identified as being discharged into the body of water.*
  • *pollution by other substances identified as being discharged in significant quantities into the body of water.*
	• *Transparency*
	• *Thermal conditions*
	• *Oxygenation conditions*
	• *Salinity*
	• *Acidification status*
	• *Nutrient conditions*
	• *Specific pollutants*
	  • *pollution by priority substances identified as being discharged into the body of water.*
	  • *pollution by other substances identified as being discharged in significant quantities into the body of water.*

Source: WFD CIS Guidance document no. 10

The normative definitions provide a basis for classifying surface waters according to their ecological status. Biological as well as supporting hydromorphological and physico-chemical elements are to be used in assessment of ecological status. Ecological status classification should be made based on relevant biological and physico-chemical monitoring results. The ecological status is represented by the lower of the value of the biological and physico-chemical monitoring results for the relevant quality element.

Chemical status classification consists of priority pollutants (33) and certain other pollutants (8):
alachlor, anthracene, atrazin, benzene, brominated diphenylether, pentabromodiphenylether (congener numbers 28, 47, 99, 100, 153 and 154), cadmium and its compounds, chloroalkanes C10-13, chlorfenvinphos, chloropyrifos, 1,2-dichloroethane, dichloromethane, di(2-ethylhexyl)phthalate (DEHP), diuron, endosulfan, fluoranthene, hexachlorobenzene, hexachlorobutadiene, hexachlorocyclohexane, isoproturon, lead and its compounds, mercury and its

compounds, naphthalene, nickel and its compounds, nonylphenol (4-nonylphenol), octylphenol (4-(1,1,3,3-tetramethylbutyl)-phenol), pentachlorbenzene, pentachlorophenol, polyaromatic hydrocarbons (benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, indeno(1,2,3-cd)pyrene), simazine, tributylthin compounds (tributylthin cation), trichlorobenzenes, trichloromethane (chloroform), trifluralin.

5.1.3 Reference conditions

According to the WFD reference conditions need to be established for water body types and quality elements which in turn are represented by parameters indicative of the status of the quality elements. Quality elements may however be excluded from the assessment procedure, and hence establishment of reference conditions is not necessary. In addition, it may be difficult to establish type-specific reference communities for all quality elements with acceptable precision. However, certain biological quality element indicators, such as taxa richness or the presence of sensitive taxa, may be less variable than others (e.g. community composition) and hence more reliably inferred (e.g. if few reference sites are available). Furthermore, it should be emphasised that the reference conditions should be established for the same quality element indicators that will be used for the classification of ecological status.

The basis for the identification of reference conditions is given in Annex II, 1.3 in the WFD. Without any specific ranking of the methods the main options for establishing reference conditions are:

- ✓ Spatially based reference conditions identified by using data from monitoring sites;
- ✓ Reference conditions identified based on predictive modelling;
- ✓ Temporally based reference conditions established by using either historical data or paleoreconstruction or a combination of both;
- ✓ Reference conditions established by using a combination of the above approaches.

In the cases where it is not possible to use mentioned methods, reference conditions can be established with expert judgement. It should be noted that establishing reference conditions for many quality elements may involve using more than one of the methods.

Spatially based reference conditions

If undisturbed (reference sites) or minimally disturbed sites ("near natural sites") are available and the data are adequate for determining a reliable measure of mean, median or mode and distribution of values (percentiles, confidence limits), then the use of survey data is one of the most straightforward methods available for establishing reference conditions. This is done a priori by collection of data from reference sites only, by using inclusion/exclusion criteria for delineating a reference population. One of the reasons that spatially based or survey approaches are commonly used is that they can be designed to include natural variability.

Reference conditions based on predictive modelling

When adequate numbers of representative reference sites are not available in a region/type, predictive modelling, using the data available within a type or "borrowing" data from other similar types, can be used in model construction and calibration. One of the advantages of using predictive approaches is that the number of sites needed for reliable estimates of mean or median and error are usually lower than those needed if spatial approaches are used. This usually results in fewer sites that need to be sample, and lower implementation costs. A second advantage of using predictive approaches is that the models can often be “inverted” to examine the likely effects of mitigation measures. It must be stressed that predictive models only are valid for the ecoregion and water body type they are created for.

Temporally based reference conditions

Temporally based reference conditions may be based on either historical data or paleoreconstruction, or a combination of both approaches. Both of these approaches are commonly used in areas where human-induced stress is widespread and unperturbed references are few or lacking entirely. For example, paleoreconstruction of past conditions may be determined either directly, based on species presence/absence from fossil remains or indirectly, using relationships between fossil remains and inference to determine other values such as the reference pH situation. Advantage is that recent step-changes in ecological status are more easily determined. A second strength of palaeoreconstruction is that if strong relationships exist between land use and ecosystem composition and function, a predictive approach may be used to predict quality elements prior to major alterations in land use (e.g. pre-intensive agriculture). Both of these approaches share, however, some of the same weakness. They are usually site and organism-specific, and hence may be of limited value for establishing type-specific values. Regarding paleoreconstruction, caution should also be exercised in unequivocal reliance on this method as providing the definitive value, as choice of the calibration dataset used to infer ecological status may result in different values. Regarding the widespread use of historical data, it may be limited by its availability and unknown quality.

Establishing reference conditions using expert judgement

Expert judgement usually consists of a narrative statement of expected reference condition. Although an expert´s opinion may be expressed semi-quantitatively, qualitative articulation is probably most common. Use of expert judgement may by warranted in areas where reference sites are lacking or few. However, one of the strengths of this approach is that it may also be used in combination with other methods. For example, expert judgement may be used to extrapolate findings from one quality element to another (i.e. paleoreconstruction using fossil diatom remains may be used to infer invertebrate community composition) or to extrapolate dose-response relationships to those expected in unperturbed sites. Another strength of this approach is that both empirical data and opinion can be amalgamated with present-day concepts of ecosystem structure and function. However, as a number of weaknesses are inherently associated with this approach, caution should be exercised when using this approach as the sole means of establishing reference condition. For example, subjectivity (e.g. the common perception that it was always better in the past) and bias (e.g. even sites with low diversity can be representative) may limit its usefulness. Other drawbacks include the lack of clarity or low degree of transparency in assumptions used to establish reference and the lack of quantitative measures (e.g. mean or median values) for validation. A further weakness of this is that the measure obtained is often static, and hence does not include the dynamic, inherent variability often associated with natural ecosystems.

A set of criteria is suggested which elaborate the degree of acceptable anthropogenic pressure and tolerable changes in quality elements that would provide the limits of high status sites or values.

5.1.4 Normative definitions

WFD sets the normative definitions for individual biological quality elements (phytoplankton, phytobenthos and macrophytes, benthic invertebrates, fish), for each category (e.g. rivers, lakes) and for high, good and moderate status. Definitions for maximum, good and moderate ecological potential for heavily modified or artificial water bodies are also given for each quality element.

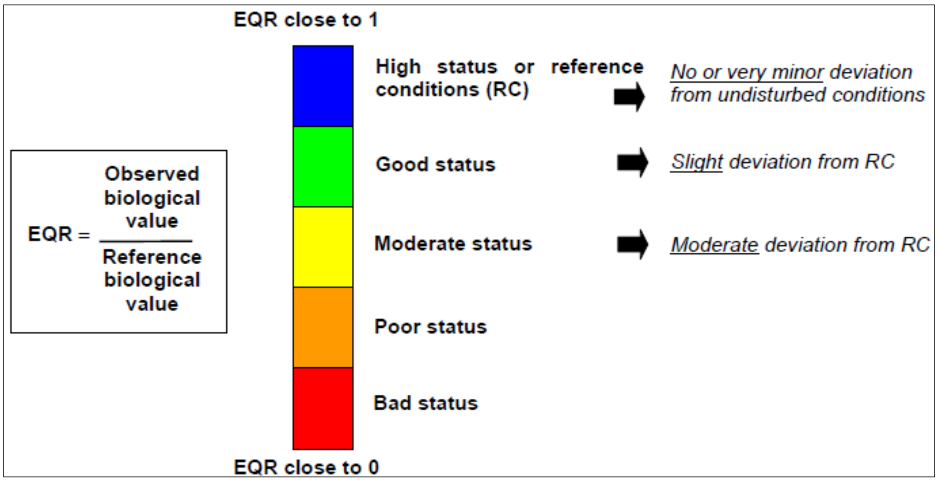
Generally for high status - There are no, or only very minor, anthropogenic alterations to the values of the physico-chemical and hydromorphological quality elements for the surface water body type from those normally associated with that type under undisturbed conditions. The values of the biological quality elements for the surface water body reflect those normally associated with that type under undisturbed conditions, and show no, or only very minor, evidence of distortion. These are the type specific conditions and communities.

Generally for good status - The values of the biological quality elements for the surface water body type show low levels of distortion resulting from human activity, but deviate only slightly from those normally associated with the surface water body type under undisturbed conditions.

Generally for moderate status - The values of the biological quality elements for the surface water body type deviate moderately from those normally associated with the surface water body type under undisturbed conditions. The values show moderate signs of distortion resulting from human activity and are significantly more disturbed than under conditions of good status.

Normative definitions should express the taxonomic composition and abundance; the ratio of disturbance sensitive taxa to insensitive taxa and the level of diversity. Expressing is done using metrics and/or indices. Observed value of metric and/or index is divided by reference value of metric and/or index. Results of assessment varied between 0 and 1.

Figure 9: Basic principles for classification of ecological status based on Ecological Quality Ratio (EQR).



Source: WFD CIS Guidance document no. 10

5.1.5 Setting Ecological Quality Rations - based class boundaries

In order to ensure comparability of monitoring systems, the results of the systems operated shall be expressed as ecological quality ratios for the purposes of classification of ecological status. These ratios shall represent the relationship between the values of the biological parameters observed for a given body of surface water and the values for these parameters in the reference conditions applicable to that body. The ratio shall be expressed as a numerical value between zero and one, with high ecological status represented by values close to one and bad ecological status by values close to zero.

Ecological quality ratio scale should be divided for each surface water category into five classes ranging from high to bad ecological status by assigning a numerical value to each of the boundaries between the classes. The value for the boundary between the classes of high and good status, and the value for the boundary between good and moderate status shall be established through the inter-calibration exercise.

There are three alternative options for setting class boundaries:

A. With access to sufficient data from sites or historical records, class boundaries may be set as follows for an individual quality element indicator:

1. Establish a suitable summary statistic (e.g. median value or arithmetic mean) of the values pertaining to reference conditions or high status – the reference value.
2. Divide the values pertaining to reference conditions (or high status) by the reference value, thus creating a set of normalised values pertaining to reference conditions (or high status). These values are ratios between observed values and the reference value, and as such potential EQR values for the borderline between high and good status.
3. Invert the normalised values if the nominal values increase toward the "bad end" of the scale. This is necessary in order to achieve a final scale that descends from 1 to 0.
4. Select a suitable statistic among the normalised values to represent the class boundary between high and good status, e.g. the 10th percentile.
5. Repeat step 2 (and if necessary 3) for values pertaining to good status, i.e. divide by the reference value and (if necessary) invert.
6. Select a suitable statistic among the normalised values arrived at in the preceding step to represent the class boundary between good and moderate. If the 10th percentile were selected in step 4, the same statistic (of the values representing good status) would be selected here.

B. With scarce access to data from sites or historical records corresponding to ecological quality criteria, class boundaries may be set as follows for an individual quality element indicator:

1. Establish a tentative scale of ecological quality ratios based on expert judgement of what may be considered to represent appropriate intervals from high to bad quality.
2. Apply the scale on a number of real or virtual data sets and compare, by expert judgement, the resulting classification with the ecological quality criteria given by the normative definitions.
3. If necessary adjust until a scale of class boundaries has been established that results in a classification corresponding to the ecological quality criteria.

C. A statistical distribution approach may be used if the ecological quality criteria represented by the normative definitions and the developments thereof are deemed too weak to support any judgement of where the borderlines between quality classes should be:

1. Establish a suitable summary statistic (e.g. mean value or percentile) of the reference values.
2. Calculate EQR ratios by normalising all values of the reference dataset (i.e. divide all values by the selected reference value).
3. Determine the “upper anchor” and in doing so the width of the high or reference band by selecting an appropriate statistic (e.g. the 10th percentile) using the distribution of the reference values. The width of this class is determined by the natural variation associated with undisturbed or least impaired reference sites. The upper anchor is also the class boundary between high and good ecological status.
4. Determine the width of the four remaining classes by dividing the interval between the upper and lower anchors equally. The lower anchor used in setting classification band widths can be a zero value. However, some thought should be given to using the minimum value measured or expected to occur in nature. Setting the lower anchor to a value > 0 might be more ecologically.

5.1.6 Classification

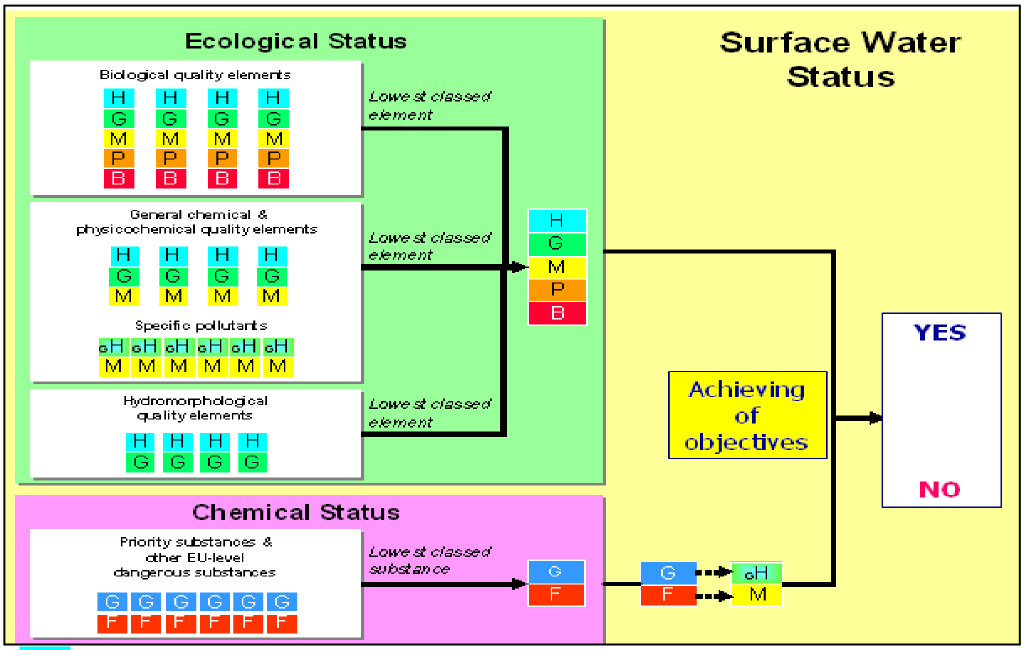
Classification of the ecological status is made based on following scheme (Figure 10). Indication of the relative roles of biological, hydromorphological and physico-chemical quality elements in ecological status classification according normative definitions is on the Figure 11.

For the specific synthetic and non-synthetic pollutants the national environmental quality standards have to be developed. Pollutants, that are toxic, persistent and liable to bio-accumulate should be relevant for individual country.

Environmental quality standard means the concentration of a particular pollutant or group of pollutants in water, sediment or biota which should not be exceeded in order to protect human health and the environment.

For the specific non-synthetic pollutants (heavy metals) the natural background concentration values should be identified for individual water bodies.

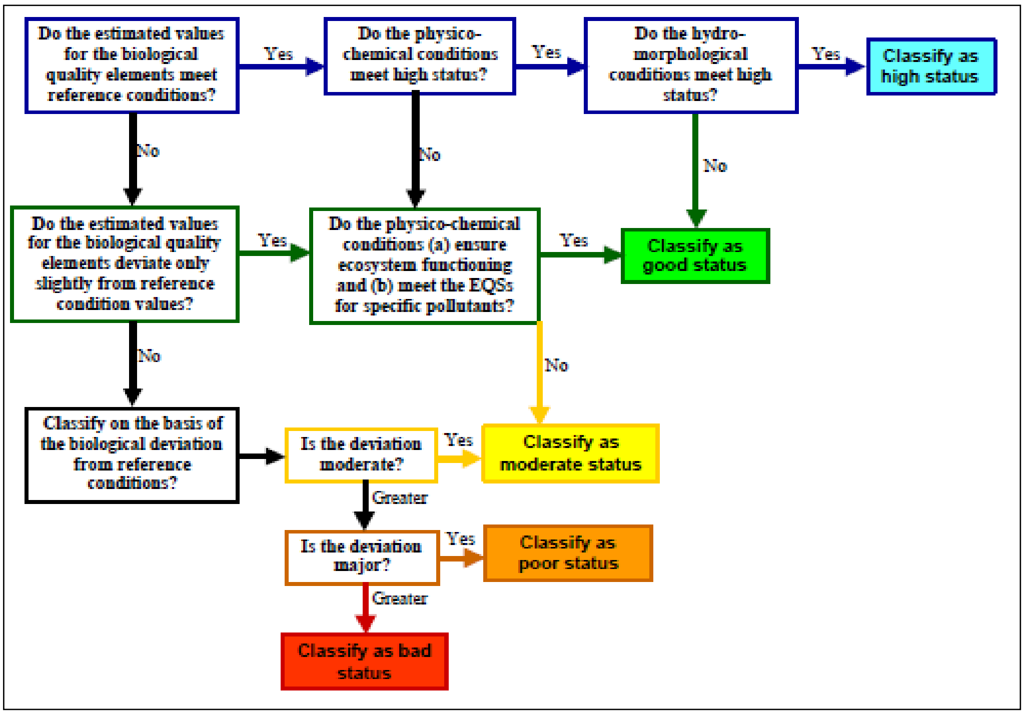
Figure 10: Basic scheme of ecological and chemical status assessment including quality elements.



H	High status
G	Good status
M	Moderate status
P	Poor status
B	Bad status
F	Failing to achieve good status

Source: WFD CIS Guidance document no. 10

Figure 11: Indication of the relative roles of biological, hydromorphological and physico-chemical quality elements in ecological status classification according normative definitions.



Source: WFD CIS Guidance document no. 10

For heavily modified and artificial water bodies the ecological potential is established. The good ecological potential is that where the good or better ecological potential has been identified and the environmental quality standards for specific synthetic or non-synthetic pollutants have not been exceeded.

For the assessment of the ecological potential the relevant water body specific classification schemes are used.

The baseline for the ecological potential is type specific classification schemes for individual biological quality elements for natural water bodies.

In the individual cases the less stringent environmental objectives can be used for the heavily modified and artificial water bodies.

5.1.7 Confidence in the status assessment

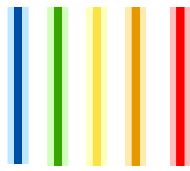
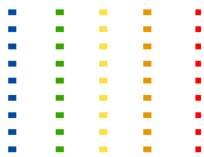
The methods regarding the assessment of ecological status vary between different countries in the Sava RB. To ensure comparability of results provided by the methods for the assessment of ecological status (comparability of water status class boundaries: high/good, good/moderate) the EU-wide inter-calibration exercise is organized. In the Sava RB the inter-calibration exercise is performed through the work of the Eastern Continental Geographical Inter-calibration Group (EC GIG), in which only Slovenia and Croatia take part so far, given their EU status. In future it will be necessary that all Sava countries would inter-calibrate to ensure a full coherence of their classification systems.

Because, at present, the inter-calibration exercise is not completed, full comparability and high confidence of ecological water status assessment results cannot be ensured throughout the entire area of the Eastern Continental region of the Sava RB. Participation of a country in the inter-calibration exercise and its completion influences the confidence level of the status data as only inter-calibrated methods can produce high-confidence data.

Most of the Sava RB countries are in the process (or at the beginning) of implementation of the ecological assessment methods only. It contains the method of sampling, sample treatment, identification, quantification, data processing and development of national classification schemes for biological quality elements as well as for supporting quality elements. Additionally the development of national environmental quality standards (EQSs) for specific synthetic and non-synthetic pollutants should be provided. This process is demanding from the point of view of technical as well as financial sources.

With regard to the above and the level of ecological status assessment methods development in the different Sava RB countries, the following method of level of confidence for ecological status assessment is proposed (Figure). This method has been successfully used in the RBMPs of some of European countries (e.g. Austria, Slovak Republic) as well as in the Danube and Tisza RBMPs.

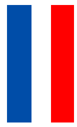
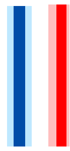
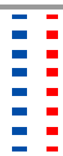
Figure 12: Confidence levels for ecological status assessment

Confidence level of correct assessment	Description	Illustration in the map
HIGH **Confidence**	All of the following criteria apply: **Biology**: • WFD-compliant monitoring data; • Biological monitoring complies fully with preconditions for sampling/analysis; • WFD compliant methods included in intercalibration process; • Biological monitoring results are supported by: • Results of hydromorphological quality elements (for structural degradation); • Results of physico-chemical quality elements (for nutrient/organic poll.); • Aggregation (grouping procedure) of water bodies in compliance with WFD shows plausible results. **Chemistry:** • National ecological quality standards (EQS) available for specific pollutants and sufficient monitoring data (WFD compliant frequency) available; • Aggregation (grouping procedure) of water bodies in compliance with WFD shows plausible results.	
MEDIUM **Confidence**	One or more of the following criteria apply: **Biology**: • WFD compliant methods not included in intercalibration process; • WFD compliant monitoring data, but: • biological results not in agreement with supportive quality elements or • only few biological data available (possibly showing different results); • Medium confidence in grouping of water bodies; • Biological monitoring does not comply completely with preconditions for sampling and analysis (e.g. use of incorrect sampling period). **Chemistry:** • National EQS available but insufficient data available (according to WFD); • Medium confidence in grouping of water bodies.	
LOW **Confidence**	One or more of the following criteria apply: **Biology**: • No WFD-compliant methods and/or monitoring data available; • Simple conclusion from risk assessment to EQ (updated risk assessment is mandatory). **Chemistry:** • No national EQS available for specific pollutants, but data available (pollution is detectable).	

With regard to the above and the level of chemical status assessment methods development in the different Sava RB countries, the following method of level of confidence for chemical status assessment is proposed (

Figure). This method has been successfully used in the RBMPs of some of European countries (e.g. Austria, Slovak Republic) as well as in the Danube and Tisza RBMPs.

Figure 13: Confidence levels for chemical status assessment.

Confidence level of correct assessment	Description	Illustration in map
HIGH *Confidence*	**Either:** • No discharge of priority substances; ***Or all* of the following criteria apply:** • Data/measurements are WFD-compliant (12 measurements per year); • Aggregation (grouping procedure) of water bodies in compliance with WFD shows plausible results.	
MEDIUM *Confidence*	***All* of the following criteria apply:** • Data/measurements are available; • Frequency is not WFD-compliant (less than 12 measurements per year available); • Medium confidence in grouping of water bodies.	
LOW *Confidence*	***One or more* of the following criteria apply:** • No data/measurements available; • Assumption that good status cannot be achieved due to respective emission (risk analysis).	

Source: WFD CIS Guidance document no. 10

5.1.8 Methods of assessment of ecological and chemical status used within Sava RB

The Sava RB countries are in different stage in the process of development of the assessment methods for surface waters and harmonization of monitoring practice. The process of development of assessment methods comprises the improvement of the procedure of sampling, sample treatment, identification, quantification, data processing and development of national classification schemes for biological quality elements as well as for supporting quality elements. Additionally the development of national environmental quality standards for specific synthetic and non-synthetic pollutants should be provided. This process is demanding from the point of view of technical, as well as financial resources.

Also, the effective assessment of the status of surface waters implies not only availability of confident system of status assessment, but also the adequate monitoring network set-up, according to general criteria provided in WFD.

Based on obtained information from the Sava RB countries the only **Slovenia** has data on monitoring of ecological and chemical status, as well as the WFD compliant method for assessment of ecological status available.

Croatia provided the data on monitoring of the chemical and ecological status, but the regulation on methods of assessment of the surface water status was adopted in 2010 and become in force at the beginning of 2011 (NN 089/2010). The status assessment is based on modelling mostly.

In **Serbia**, the new by-law on the assessment of ecological and chemical status has been recently adopted in October 2011 (Off. Garzete of RS" 74/11). Therefore the monitoring and the assessment of the ecological and chemical status for the SRBMP have not been fully compliant with the requirements of WFD.

The assessment of ecological and chemical status in **Bosnia and Herzegovina** is based on national legislative (Sl. glasnik RS 42/01 and Sl. novine FBiH, broj 18/98). Bosnia and Herzegovina has not implemented all the WFD compliant methods yet. Therefore, the assessment of the surface water status is not fully WFD compliant in the SRBMP.

The methodology of status assessment in **Montenegro** is not harmonized with requirements of the WFD up to now. The risk analysis was prepared based on the data obtained from Water Quality Yearbook 2008 and 2009. Yearbook contains data on monitoring of the rivers and reservoirs in Montenegro basically focused to the drinking water purposes.

In order to be able to assess the status/potential for all water bodies within the Sava RB, having in mind the different level of status assessment methods development in the individual Sava RB countries, as well as the gaps in monitoring practice (some water bodies are not covered by the monitoring network), for the status assessment within Sava RB, the modified approach has been used. For those countries where the method of assessment of status is missing, or in the case when monitoring data are not available for particular water body, the estimation of failure of good status (update of the risk analysis) has been prepared, based on the information on pressures on particular water body provided from the countries.

The European wide intercalibration exercise shall ensure the comparability of water status class boundaries (high/good, good/moderate) among different countries in accordance with the normative definitions of the WFD. In the Sava RB, the intercalibration exercise is partly performed through the work of the Geographical Intercalibration Groups (e.g. Slovenia in the Central and the Alpine Geographical Intercalibration Group, Slovenia and Croatia in the Eastern Continental Geographical Intercalibration Group). However, Bosnia and Herzegovina, Montenegro and Serbia do not participate in the intercalibration exercises. The intercalibration exercise of the Geographical Intercalibration Groups is not yet fully completed. Therefore, comparability and high confidence of ecological status assessment results are not yet ensured.

5.2 Ecological status/potential and chemical status assessment

Out of total 189 water bodies the ecological status of 183 water bodies in the Sava River and its tributaries has been assessed. A high ecological status has been achieved only in 10 water bodies. A good ecological status was assessed at 65 water bodies. The majority of water bodies (70) had moderate status. Poor status was found at 17 WBs, while no water bodies had a bad status. Ecological potential was assessed at 20 HMWB/candidates on Sava, Vrbas, Bosut, Drina, Lim and Kolubara. In 17 WBs, a good ecological potential was identified and in three WBs a moderate ecological potential have been identified. Figure 14 shows the extent of river for the individual ecological status classes. Table 8 presents the assessment of the ecological status in the Sava River and its tributaries. National assessments of the status the surface water bodies in the

Sava River Basin are given in the Annex 2. With the exception of Slovenia, the status assessment does not fully comply with WFD requirements.

Table 8: The assessment of the ecological status for Sava River and its tributaries

	Sava River		Tributaries	
	No. of WBs	**Length (km)**	**No. of WBs**	**Length (km)**
High status	0	0	10	232,78
Good status	5	81.21	60	1,661.84
Moderate status	15	562.50	55	1,648.91
Poor status	5	295.73	12	392.36
Bad status	0	0	0	0
No data	0	0	5	99.63

Note: The presented total length of the Sava River and its tributaries is different from the real length due to problems with harmonisation of trans-boundary water bodies (lengths of all delineated WBs counted in cases when different lengths of WBs on trans-boundary stretches were reported by the neighbouring countries).

It should be mentioned that the results of the assessment of ecological status and ecological potential had low and medium confidence. Assessments of high ecological status with low confidence comprised 93.75% and with medium confidence 6.25%; good ecological status (medium confidence – 20.29%, low confidence – 79.71%); moderate ecological status (medium confidence – 31.25%, low confidence – 68.85%) and poor ecological status (medium confidence – 10.53%, low confidence – 89.47%).

The most frequently measured biological quality element used for an ecological status assessment was benthic invertebrates. It was used to classify ecological status in the majority of the evaluated water bodies. Among the pollutants most frequently measured were non-synthetic compounds (arsenic, copper, zinc and chromium). The national environmental quality standards for specific pollutants were exceeded in several water bodies (Sotla/Sutla, Sava, and Spreča rivers).

176 water bodies had good chemical status and 26 water bodies did not have good chemical status. 13 water bodies were not assessed. Table 9 shows the number of water bodies and the length of water bodies which did or did not have good chemical status.

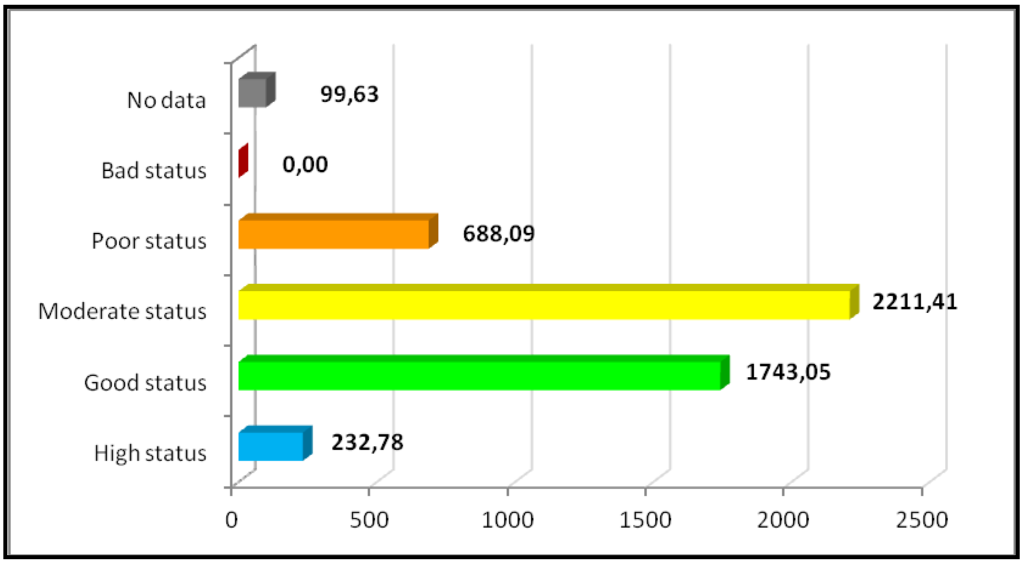
The confidence level for the assessment of water bodies in good chemical status was generally low (low – 63%, middle – 29%, high – 8%). The confidence level for the assessment of water bodies which did not have good chemical status was higher (high – 6.67%, middle – 26.67%, low – 66.67%).

In the majority of water bodies with good chemical status, the assessment was done using risk analysis (low confidence). Failure to attain good chemical status was due to the detection of tributhyltin, endrin, isodrin and endosulphane (Sava River); mercury (Krka River); and nickel and cadmium (Kolubara River).

Table 9: The assessment of the chemical status for Sava River and its tributaries

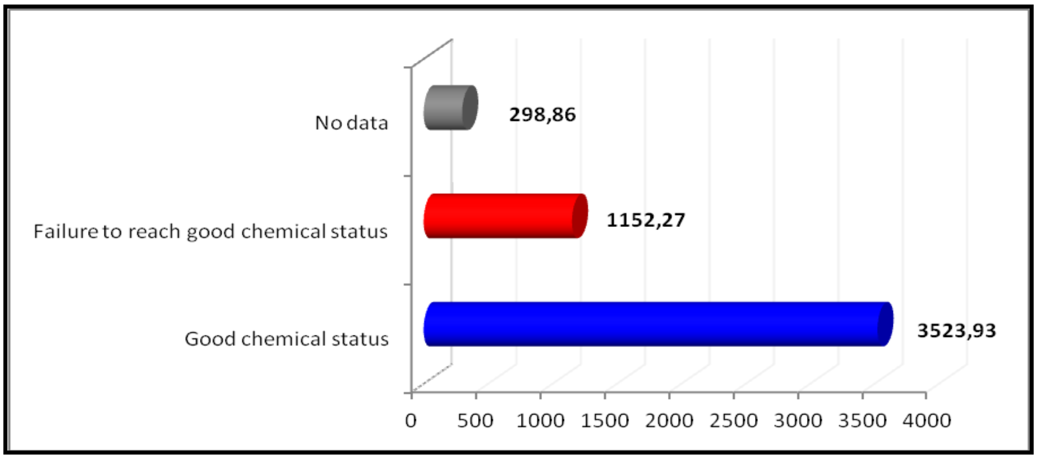
	Sava River		Tributaries	
	No. of WBs	**Length (km)**	**No. of WBs**	**Length (km)**
Good chemical status	20	683.60	108	2,840.33
Failure to reach good chemical status	5	255.84	21	896,43
No data	0	0	13	298.86

Figure 14: Length (km) of the individual ecological status classes in the Sava River and its tributaries



Note: The presented total length of the Sava River and its tributaries is different from the real length due to problems with harmonisation of trans-boundary water bodies (lengths of all delineated WBs counted in cases when different lengths of WBs on trans-boundary stretches were reported by the neighbouring countries).

Figure 15: Assessment of the chemical status in the water bodies of Sava River and its tributaries (length of water bodies – km)



Note: The presented total length of the Sava River and its tributaries is different from the real length due to problems with harmonisation of trans-boundary water bodies (lengths of all delineated WBs counted in cases when different lengths of WBs on trans-boundary stretches were reported by the neighbouring countries).

5.2.1 Gaps and uncertainties

During the assessment of the ecological status, WFD compliant methods for the analysis of biological quality elements had to be applied for the first time for a number of water bodies in the Sava RB. Great effort was needed to apply the new sampling methods for all biological quality elements, to establish appropriate classification systems and to put these new methods into practice at the national level in the EU Member States. In most of the Sava RB countries, this process is still under development. Sava RB countries have not yet managed to use all the biological quality elements required by the WFD for ecological status assessment. The key missing data were those for macrophytes and/or phytobenthos as well as for fish.

The intercalibration exercise for achieving international harmonisation and comparability of status class boundaries has not yet been fully completed and this issue requires further cooperation. In general, the reasons for low and medium confidence regarding the ecological status assessment were:

- Lack of the monitoring data;
- Not all biological methods, which were applied for assessment of the individual quality elements were WFD compliant;
- Biological quality elements were not fully supported by additional parameters (physico-chemical and hydromorphological) in the national classification schemes for ecological status assessment;
- Methods for assessment of ecological potential are not developed in all Sava RB countries;
- Relevant river basin specific pollutants not identified in all countries;
- Monitoring schemes in the individual countries are not fully WFD-compliant (e.g. not monitored at required frequencies).

These results indicate that achieving a fully coherent and WFD compliant ecological status assessment in the Sava RB requires additional time. As a consequence, there are shortcomings related to the final designation of HMWBs. The final HMWB designation still needs validation based on high confidence assessment results regarding the ecological status.

Chemical status assessment of the surface water bodies is based on results of monitoring in combination with estimation of the risk of failure good status achieving. The reasons for low and medium confidence were:

- General lack of monitoring data;
- Monitoring schemes in the individual countries are not fully WFD-compliant (not all WFD PS has been monitored in all countries; not at required frequencies);
- The methodologies for analysis of WFD PS and assessment of chemical status not fully compliant with the QA/QC Directive (2009/90/EC) and 2008/105/EC Directive.

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Annex 1

Details on surface water body delineation and status assessment in the Sava River Basin

<u>During the harmonization process it is needful:</u>

- visualization in maps – to unify the course of stretches located on the borders and the course of borders too
- assessment of status – to unify the categorization and assessment of water bodies

<u>Comments to particular details No. 1, 2, 3:</u>

HR missing WB

- missing stretches of HR surface water bodies: light blue lines in the red circles, there is used the river line for visualisation purposes

- missing stretches of HR surface water bodies: light blue line in the red circle represents missing mouth of the river, there is used the river line for visualisation purposes; in the next circle there is any line missing

SI and HR Geometry Generalization Examplef

- red line – original SI water bodies line

- black line – original HR water bodies line

- blue line – new generalized line of water bodies, the line is generalized according the SI border line, because the geometry of SI border line was evaluated as better/more precise; the generalized line was copied 2 times, first line was divided according SI delineation of water bodies, second line was divided according HR delineation of water bodies

<u>In all of map details are used the generalized lines of water bodies.</u>

<u>Comments to particular details of map of ecological status and potential assessment:</u>

Detail Situation

- summary map of ecological status and ecological potential assessment with marked location of each detail A - H

Detail A.

- different delineation of water bodies and different status assessment of water bodies on the SI-HR border

Detail B.

- different delineation of water bodies and different status assessment of water bodies on the SI-HR border

Detail C.

- different delineation of water bodies and different status assessment of water bodies on the HR-BA border

Detail D.

- quite similar delineation of water bodies but different status assessment of water bodies on the HR-BA border

Detail E.

- different delineation of water bodies and different status assessment of water bodies on the HR-BA border

Detail F

- different delineation of water bodies and different status assessment of water bodies on the BA-RS border

- on the left – missing BA water body status assessment

Detail G.

- different delineation of water bodies and different status assessment of water bodies on the BA-RS border;

- missing BA water body on the Uvac river;

- incorrect border line river.

Detail H.

- missing status assessment of BA water body on the BA-ME border (grey line);

- missing BA water body and its status assessment on the BA-ME border

<u>Comments to particular details of map of chemical status assessment:</u>

Detail 0 Situation

- summary map of chemical status assessment with marked location of each detail A - H

Detail A.

- different delineation of water bodies and missing SI water bodies status assessment (grey lines) on the SI-HR border

Detail B.

- different delineation of water bodies and different status assessment of water bodies on the SI-HR border

Detail C.

- different delineation of water bodies on the HR-BA border

Detail D.

- quite similar delineation of water bodies but different status assessment of water bodies on the HR-BA border

Detail E.

- different delineation of water bodies and different status assessment of water bodies on the HR-BA border

Detail F.

- different delineation of water bodies and different status assessment of water bodies on the BA-RS border

- on the left – missing BA water body status assessment

Detail G.

- different delineation of water bodies and different status assessment of water bodies on the BA-RS border;

- missing BA water body on the Uvac river;

- strange border line course

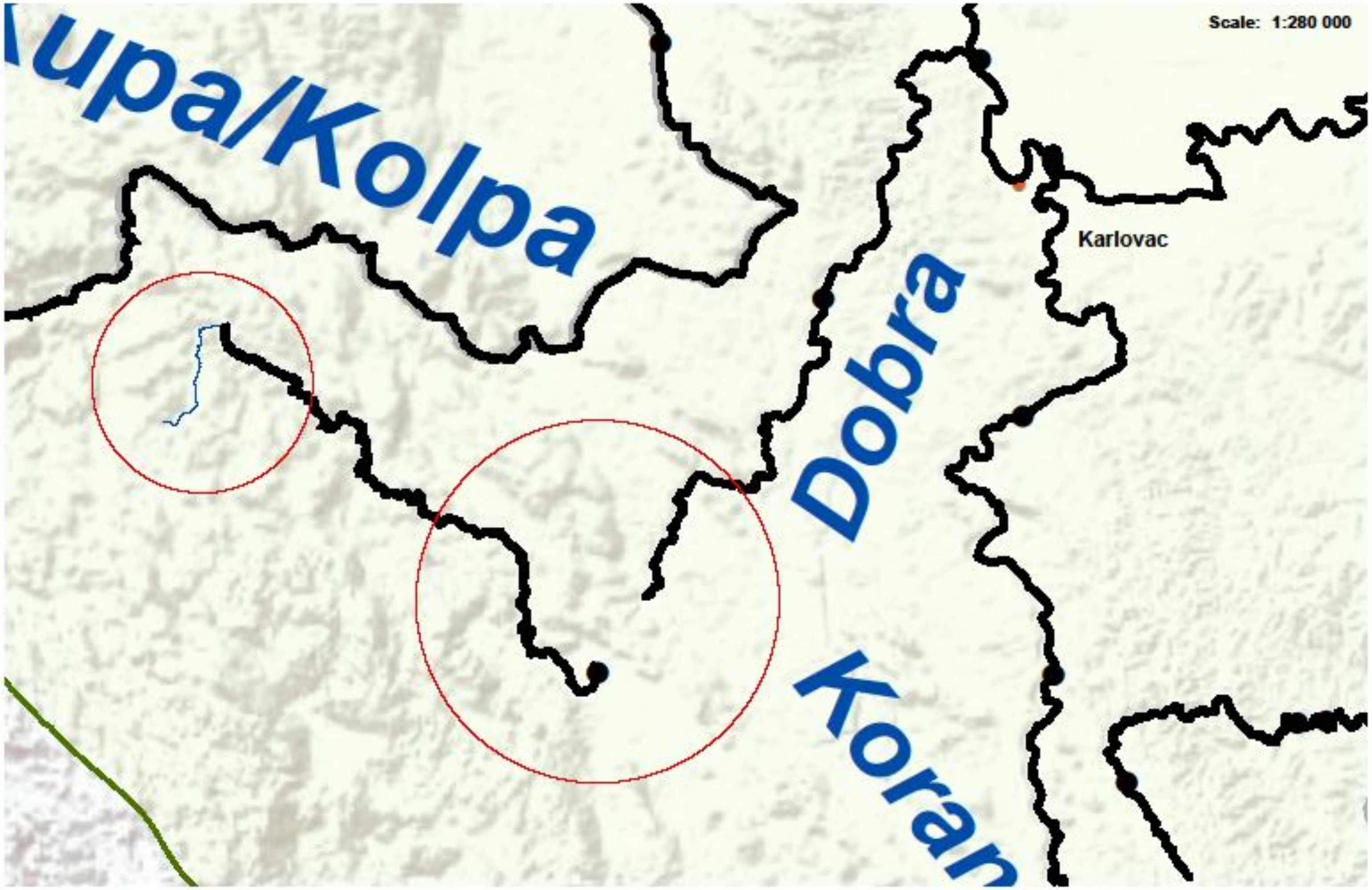
DetailH.

- missing status assessment of BA water body on the BA-ME border (grey line);

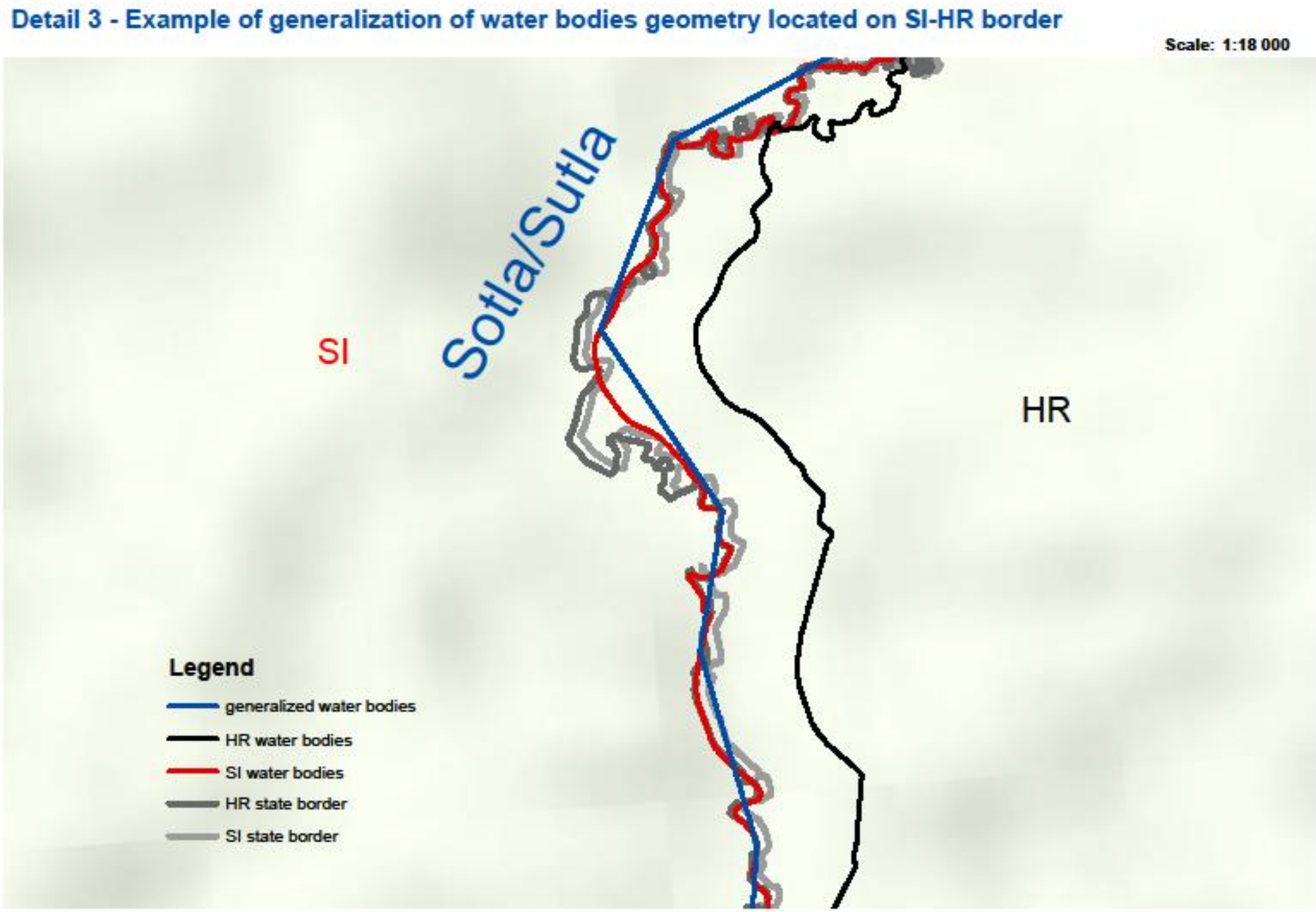
- missing BA water body and its status assessment on the BA-ME border

Detail 1 - Missing surface water bodies

Detail 2 - Missing surface water bodies

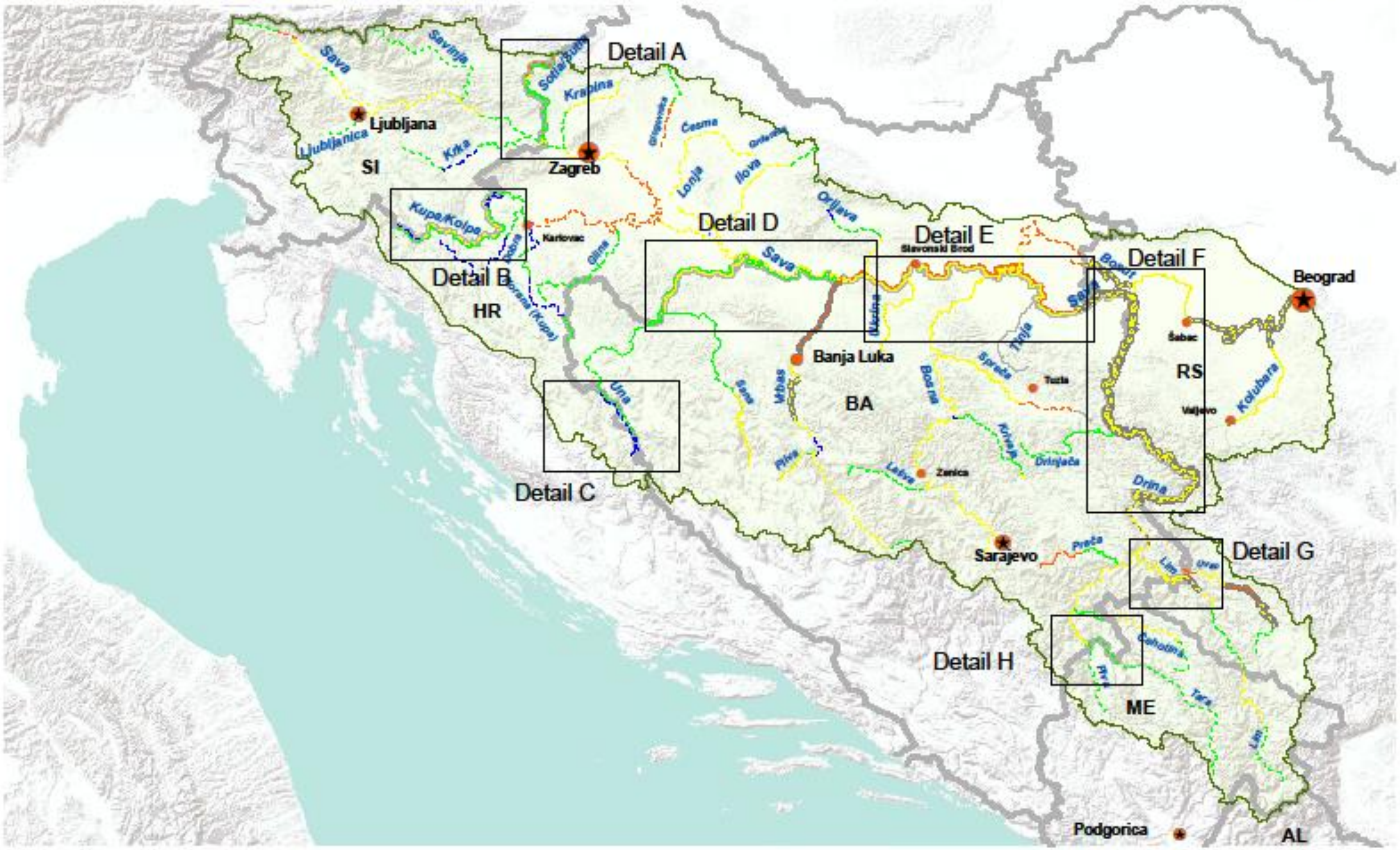


Detail 3 - Example of generalization of water bodies geometry located on SI-HR border


Detail 3 - Example of generalization of water bodies geometry located on SI-HR border
Scale: 1:18 000
Sotla/Sutla
SI
HR
Legend
generalized water bodies
HR water bodies
SI water bodies
HR state border
SI state border

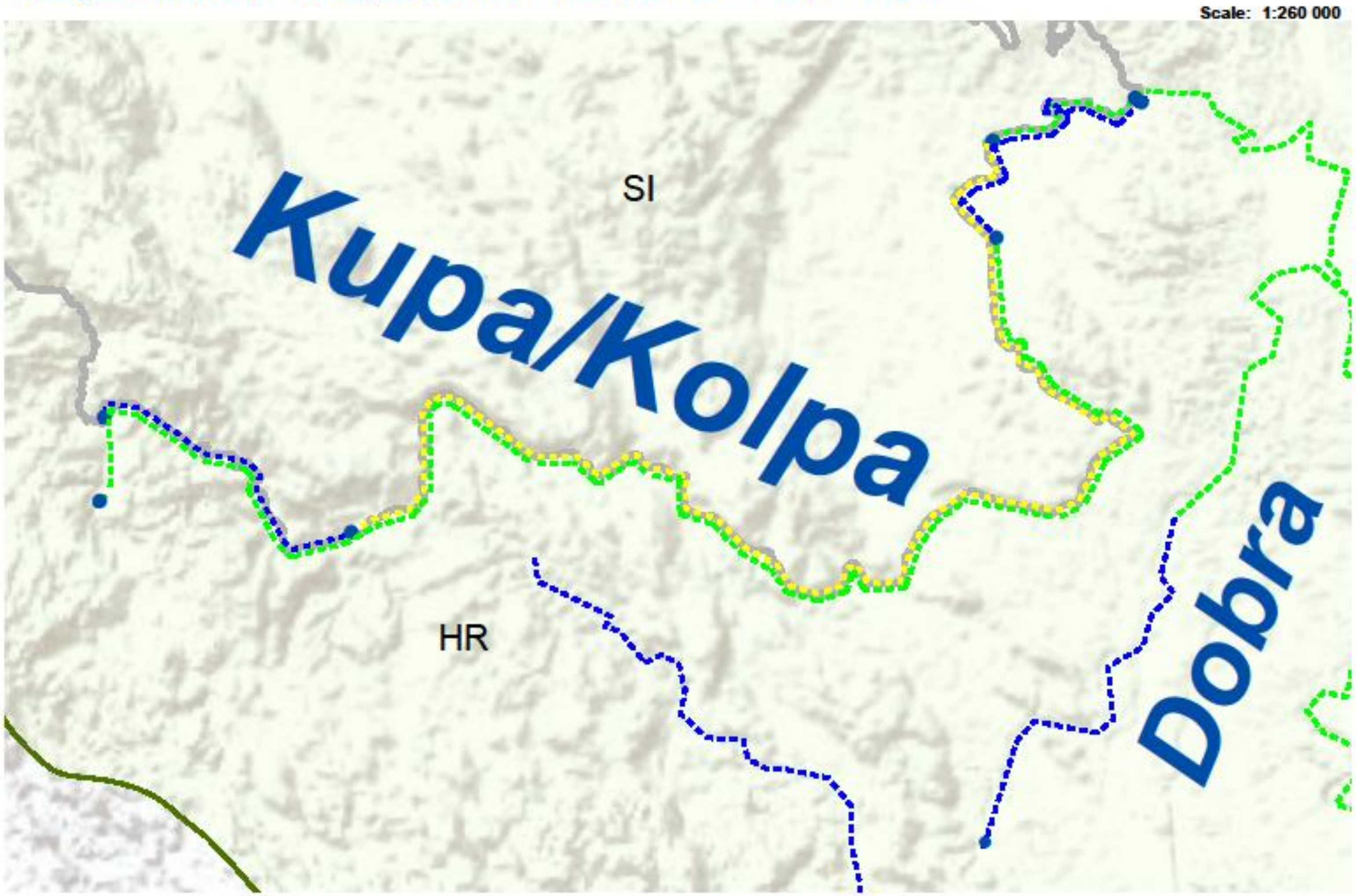
Ecological status and Ecological potential of surface water bodies

Scale: 1:1 800 000

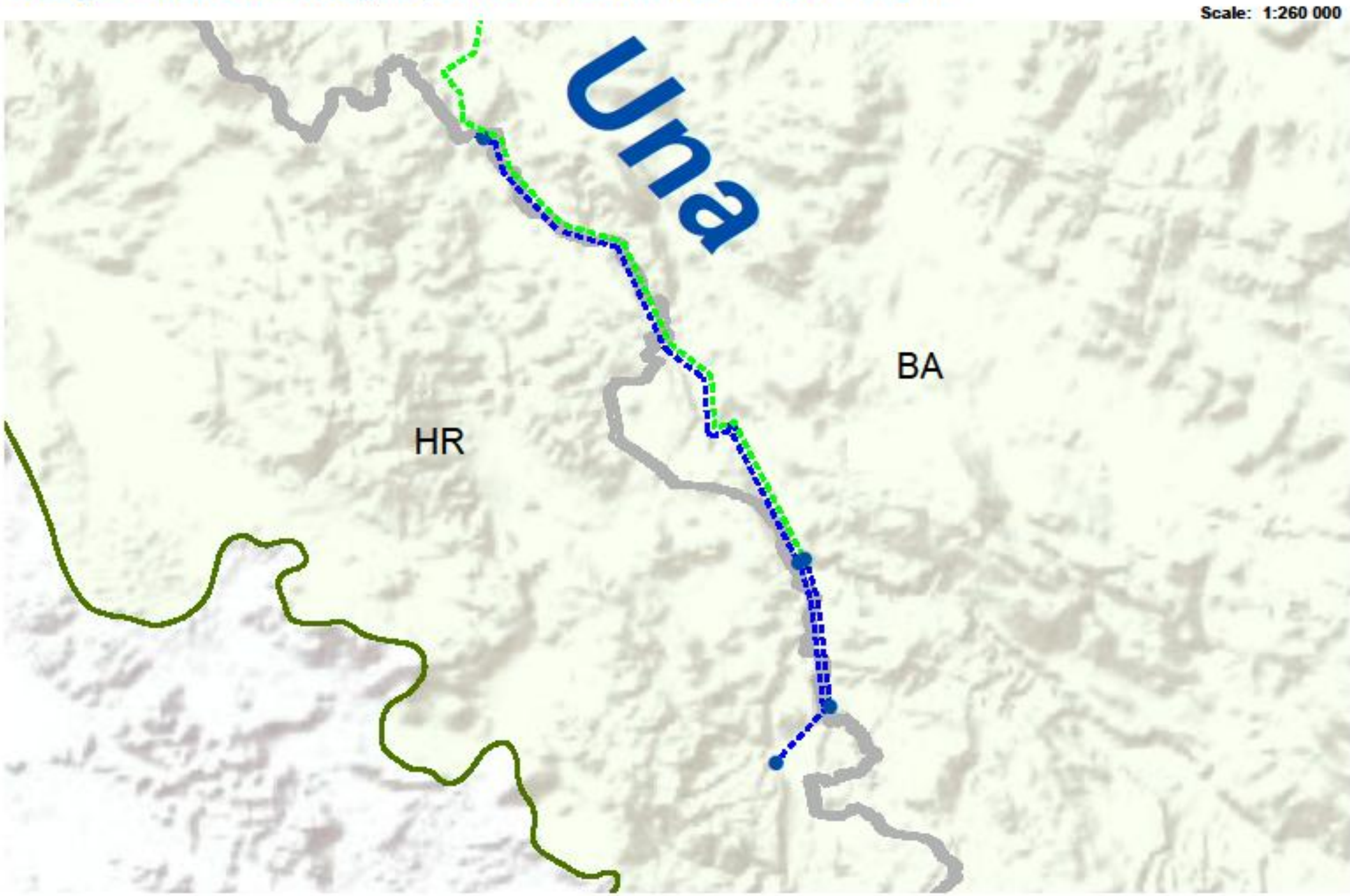



Ecological status and Ecological potential of surface water bodies - detail A
Scale: 1:230 000
Sotla/Sut
SI
HR
Kra

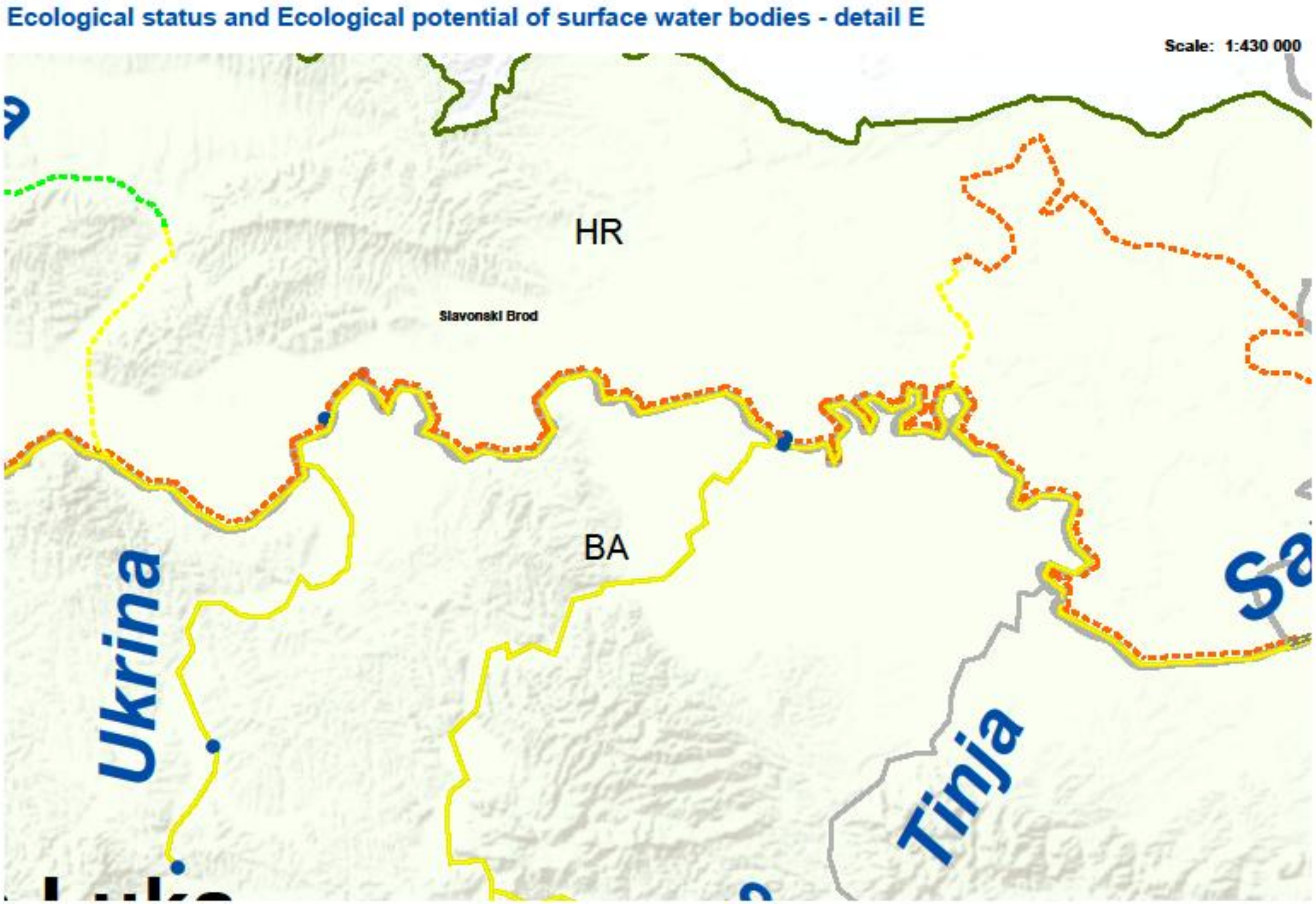
Ecological status and Ecological potential of surface water bodies - detail B



Ecological status and Ecological potential of surface water bodies - detail C

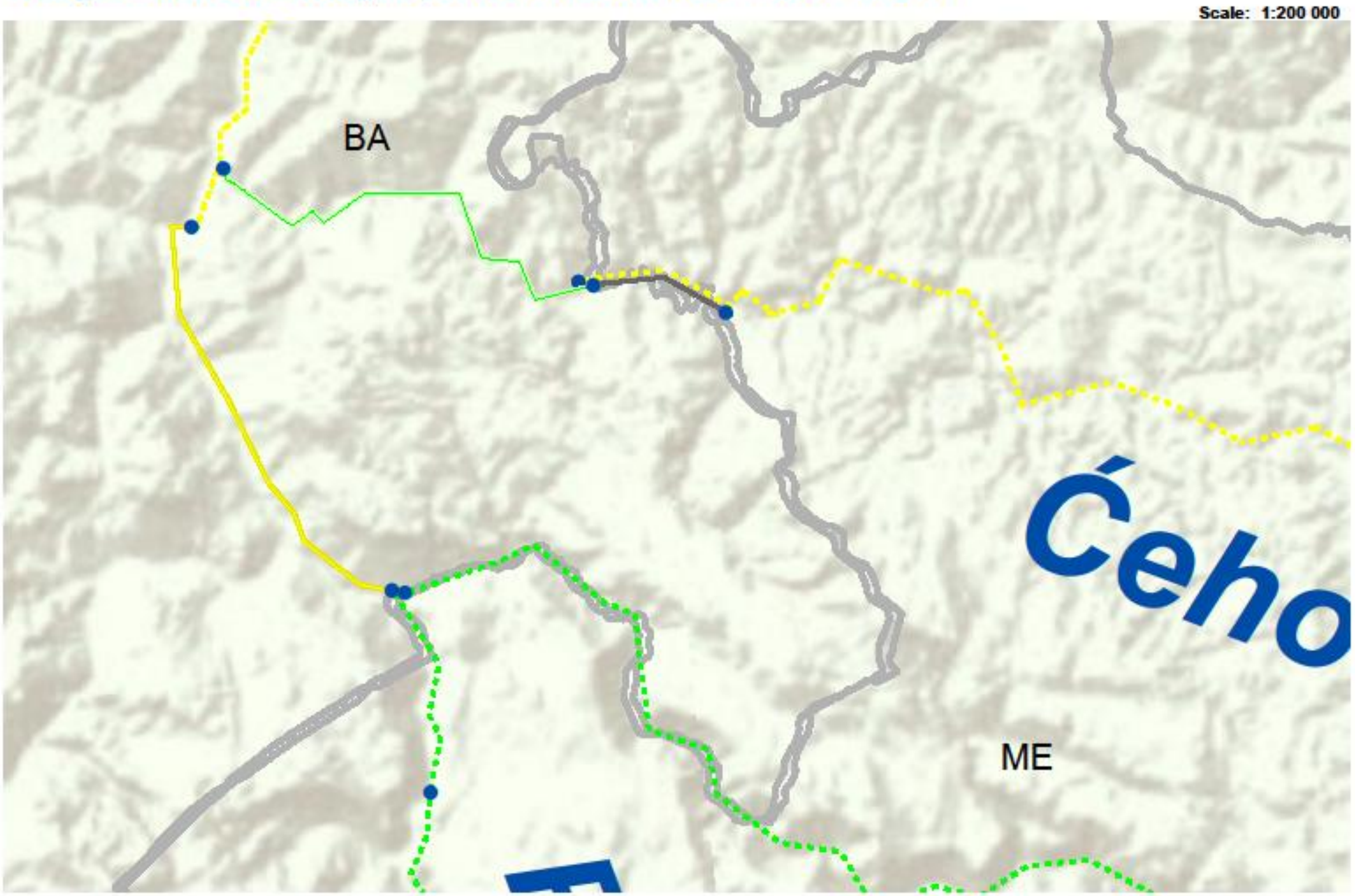


Ecological status and Ecological potential of surface water bodies - detail D


Ecological status and Ecological potential of surface water bodies - detail E
Scale: 1:430 000
HR
Slavonski Brod
BA
Ukrina
Tinja


Ecological status and Ecological potential of surface water bodies - detail F
Scale: 1:540 000
Sava
Šabac
RS
BA
Valjevo
jača
Drina
Prača

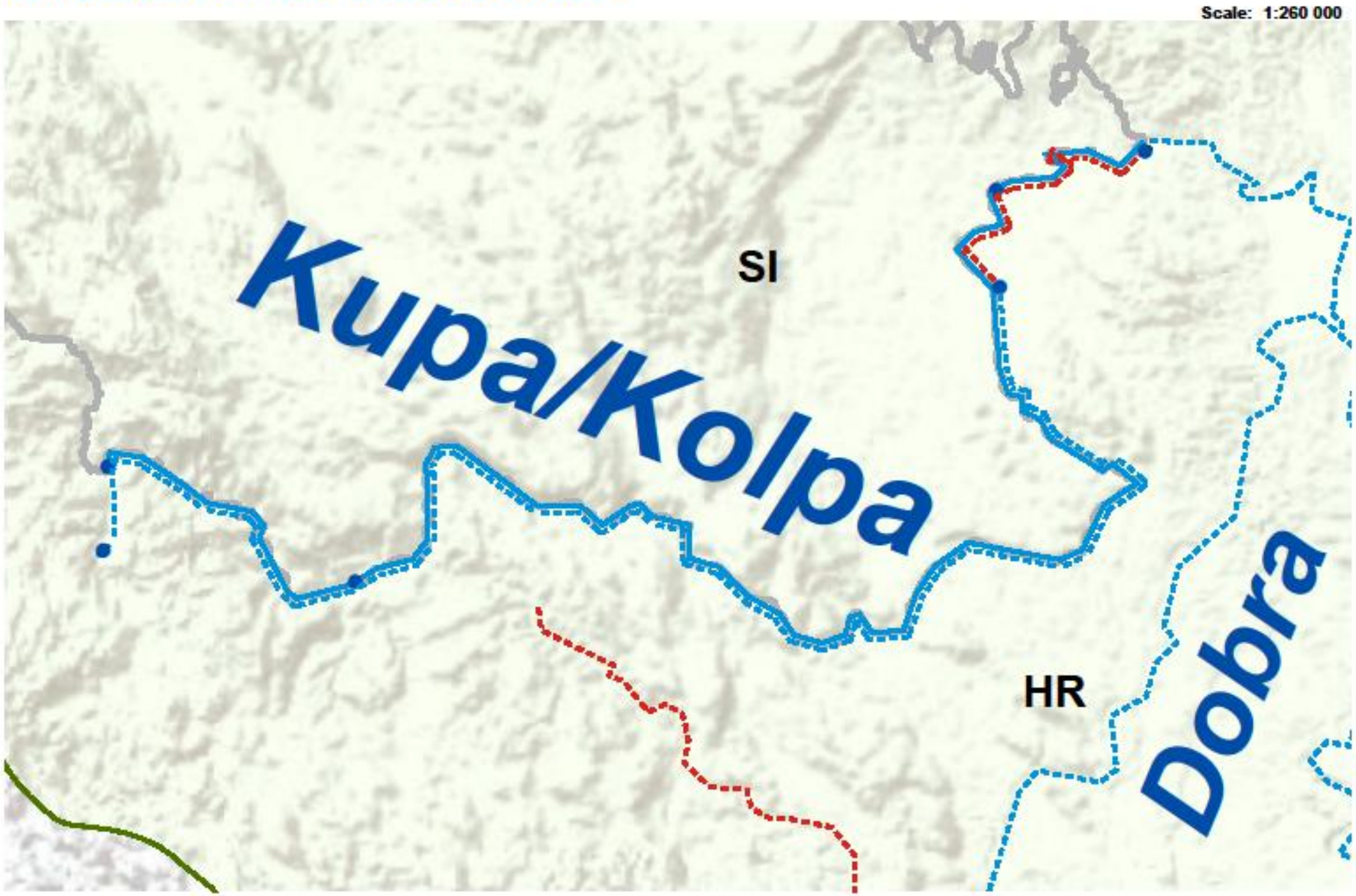
Ecological status and Ecological potential of surface water bodies - detail H



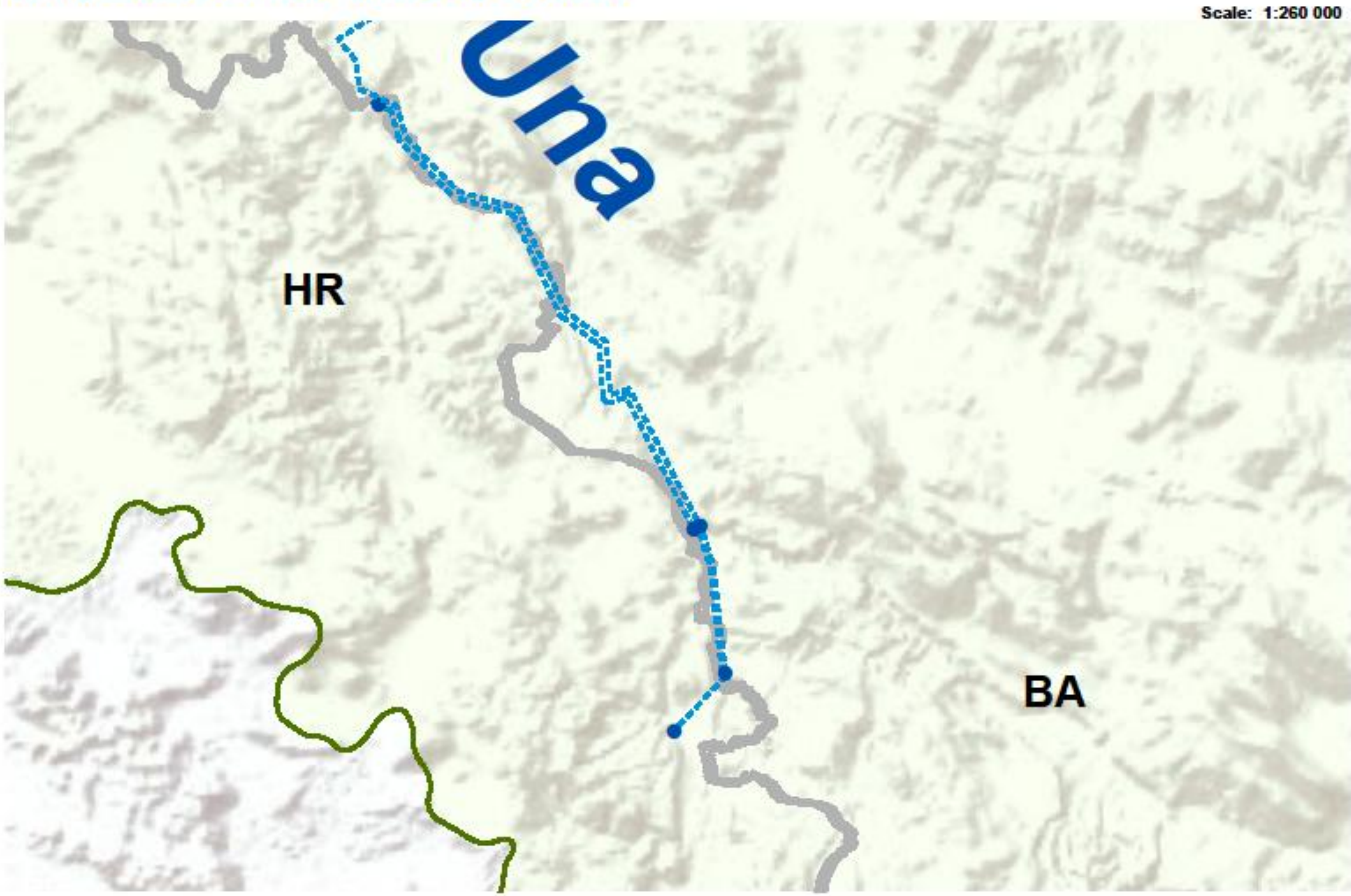

Chemical status of surface water bodies
Scale: 1:1 800 000
Detail A
Detail B
Detail C
Detail D
Detail E
Detail F
Detail G
Detail H
Ljubljana
Zagreb
Karlovac
Slavonski Brod
Banja Luka
Tuzla
Zenica
Sarajevo
Šabac
Valjevo
Beograd
Podgorica
SI
HR
BA
RS
ME
AL
Sava
Savinja
Ljubljanica
Krka
Sotla/Sutla
Krapina
Kupa/Kolpa
Dobra
Korana
Glina
Česma
Lonja
Ilova
Orljava
Bosut
Una
Sana
Vrbas
Pliva
Bosna
Lašva
Spreča
Krivaja
Drinjača
Tinja
Drina
Kolubara
Lim
Uvac
Prača
Piva
Tara
Ćehotina

Chemical status of surface water bodies - detail A

Chemical status of surface water bodies - detail B

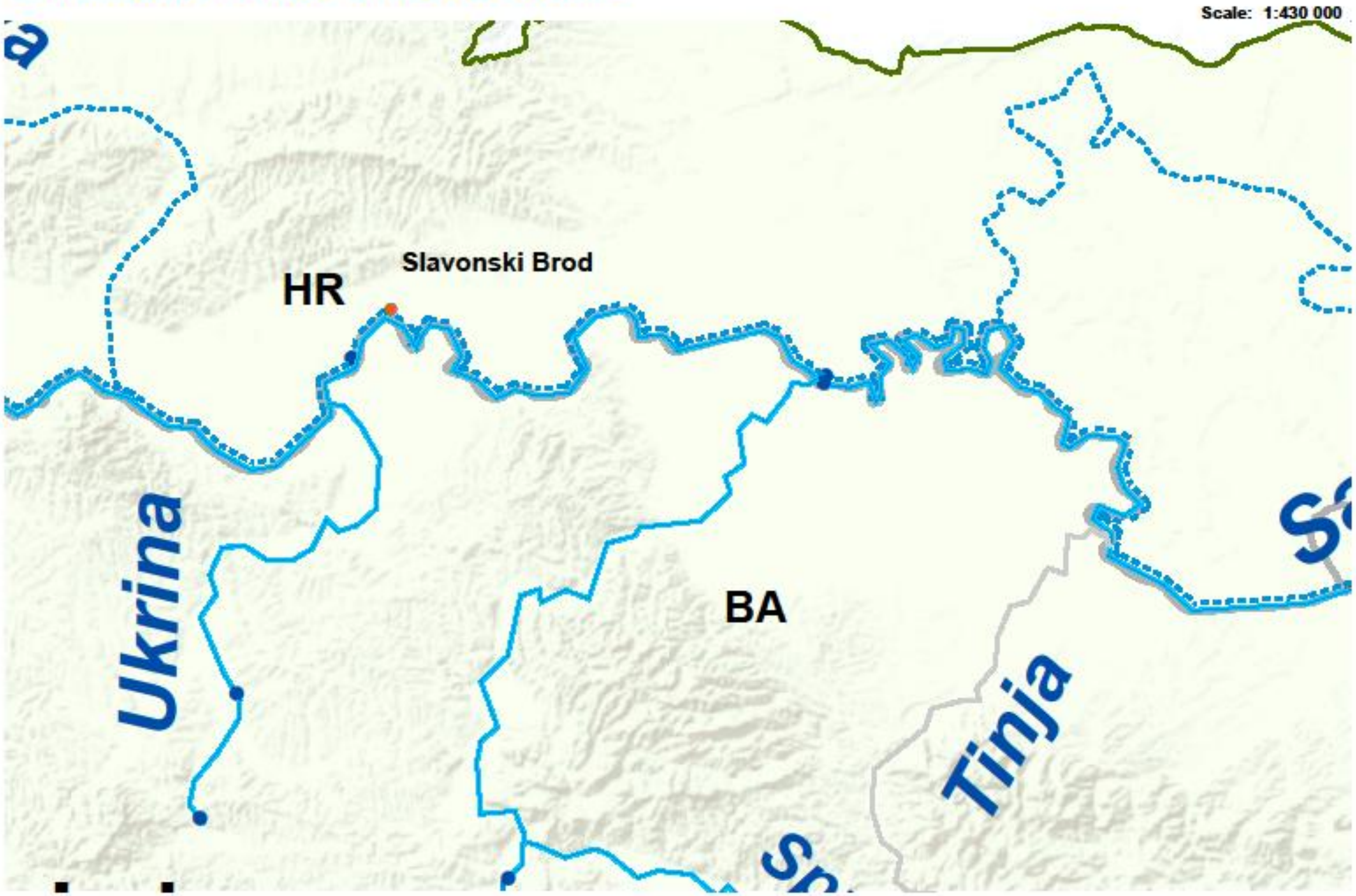


Chemical status of surface water bodies - detail C



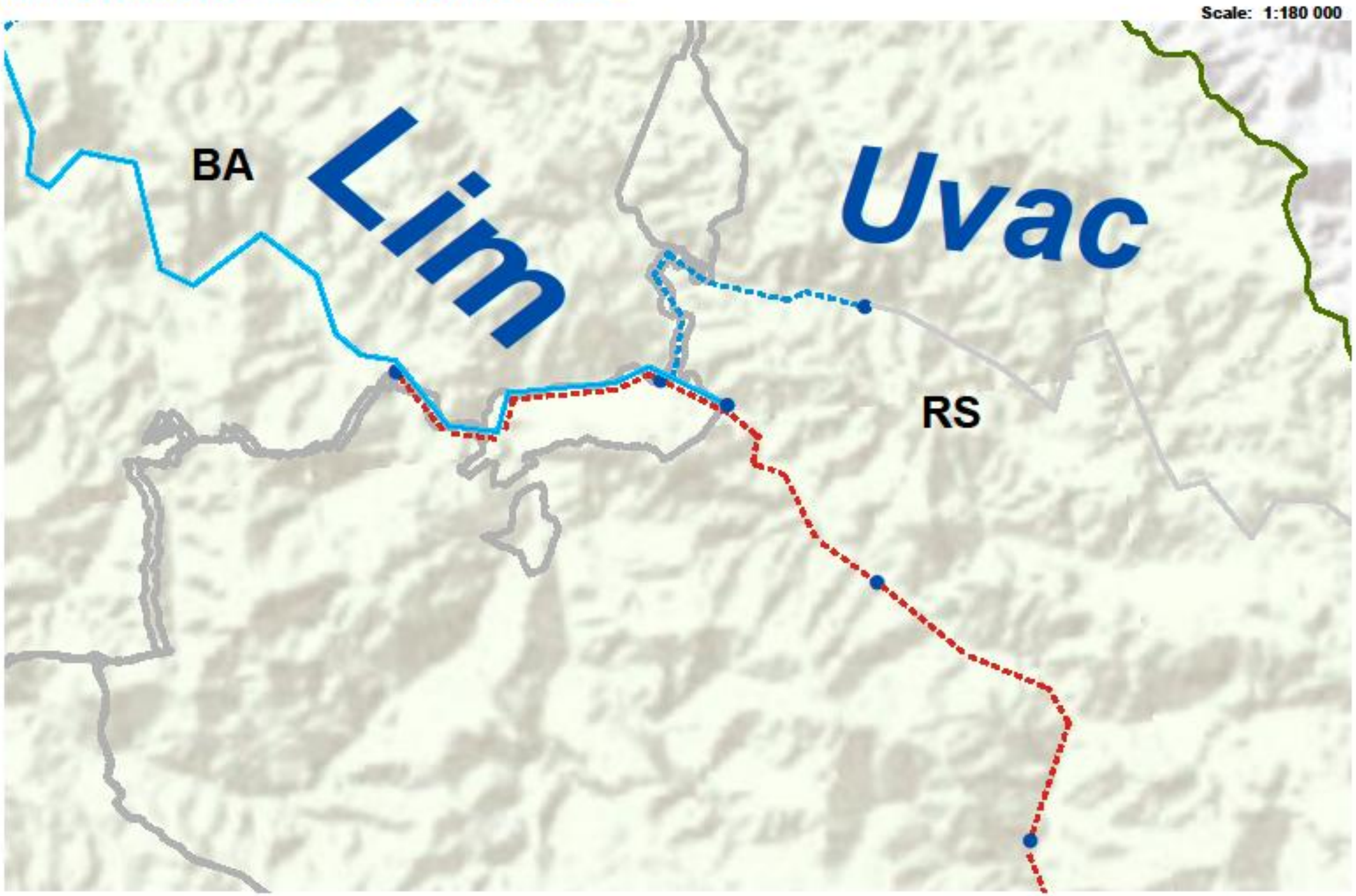
Chemical status of surface water bodies - detail D

Chemical status of surface water bodies - detail E




Chemical status of surface water bodies - detail F
Scale: 1:540 000
Sava
Šabac
BA
RS
Valjevo
jača
Drina
Prača

Chemical status of surface water bodies - detail G



Chemical status of surface water bodies - detail H

Annex 2

Surface water body status assessment in the Sava River Basin

Status assessment of surface water bodies

		Biological Quality Elements						HyMo		Specific pollutants				Artificial and HMWB			Chemical Status Class		Main Pressure			
River	Water body code	Fish	Benthic invertebrates	Phytobenthos and Macrophytes	Phytoplankton	Overall Biological Status	Confidence (Overall Biological Status)	Hydromorphology - High Status (Y/N)	General Physical and Chemical conditions	Other WB Specific pollutants (for Ecological Status Evaluation)	Confidence (Specific pollutants)	OVERALL ECOLOGICAL STATUS	Confidence class (Overall Ecol.Status)	Artificial Water Body (Y/N)	HMWB (Y/N/Candidate (C))	Ecological Potential Class	CHEMICAL STATUS CLASS	Confidence class (Chemical Status)	Organic Pollution	Nutrient Pollution	Hazardous Substances	Hydromorphological Alterations
SAVA	SI111VT5		2	2		2	L		1	2	H	2	L				2	H				
SAVA	SI111VT7		3	4		4	L		2	2	H				Y	3	2	H				
SAVA	SI1VT137		3	1		3	L		2	2	H	3	L				2	M				
SAVA	SI1VT150		1	2		2	L		2	2	H	2	L				2	M				
SAVA	SI1VT170		3	2		3	L		2	2	M				Y	3	2	H				x
SAVA	SI1VT310		3	2		3	L		2	2	H	3	L				2	H				
Ljubljanica	SI14VT77		2	2		2	L		2	2	H	2	L				2	M				
Ljubljanica	SI14VT93		2	3		3	L		2	2	H				Y	3	2	M				x
Ljubljanica	SI14VT97		2	3		2	L		2	2	H	3	L				2	H				
SAVA	SI1VT519		2	3		3	L		2	2	H	3	L				2	H				
SAVA	SI1VT557		1	3		3	L		2	2	H	3	L				2	H				
Savinja	SI16VT17		2	1		2	L		1	2	H	2	L				2	M				
Savinja	SI16VT70		2	1		2	L		2	2	H	2	L				2	M				
Savinja	SI16VT97		2	1		2	L		2	2	H	2	L				2	H				
SAVA	SI1VT713		3	2		3	L		2	2	M				Y	3	3	H				x
SAVA	SI1VT739		1	2		2	L		2	2	H	2	L				2	M				x

		Biological Quality Elements						HyMo		Specific pollutants				Artificial and HMWB			Chemical Status Class		Main Pressure			
River	Water body code	Fish	Benthic invertebrates	Phytobenthos and Macrophytes	Phytoplankton	Overall Biological Status	Confidence (Overall Biological Status)	Hydromorphology - High Status (Y/N)	General Physical and Chemical conditions	Other WB Specific pollutants (for Ecological Status Evaluation)	Confidence (Specific pollutants)	OVERALL ECOLOGICAL STATUS	Confidence class (Overall Ecol.Status)	Artificial Water Body (Y/N)	HMWB (Y/N/Candidate (C))	Ecological Potential Class	CHEMICAL STATUS CLASS	Confidence class (Chemical Status)	Organic Pollution	Nutrient Pollution	Hazardous Substances	Hydromorphological Alterations
SAVA	SI1VT913		2	2		2	L		2	2	H	2	L				2	M				
SAVA	SI1VT930		2	2		2	L		2	2	H	2	L				2	M				
Krka	SI18VT31		1	1		1	L		2	2	H	2	L				2	M				
Krka	SI18VT77		1	1		1	L		1	2	H	1	L				3	H				
Krka	SI18VT97		1	2		2	L		2	2	H	2	L				2	H				
Sotla/Sutla	SI192VT1		4	3		4	L		2	3	H	4	L				2	M				
	DSRI190002							N	2**			3*	L	N	C***		2*	L				x
	DSRI190003							N	2**			2*	L	N	N		2*	L				
Sotla/Sutla	SI192VT5		2	1		2	L		2	2	H	2	L				2	H				
	DSRI190001							N	2**			2*	L	N	N		2*	L				
Krapina	DSRN180003							N	3**			3*	L	N	N		2*	L		x		
Krapina	DSRN180002							N	3**			3*	L	N	C***		3*	L		x	x	
Krapina	DSRN180001							N	2**			2*	L	N	C***		2*	L				
SAVA	DSRI010010							N	3**			3*	L	N	N		2	L		x		
SAVA	DSRN010009							N	2**			2*	L	N	N		2	L				
SAVA	DSRN010008							N	2**			3*	L	N	C***		2	L				x
SAVA	DSRN010007							N	2**			4*	L	N	C***		2	L				x
SAVA	DSRN010006							N	2**			3*	L	N	C***		2	L				x
Kupa/Kolpa	SI21VT13		1	1		1	L		1	2	H	1	L				2	H				
	DSRI020003							N	1**			1*	L	N	N		3*	L			x	

		Biological Quality Elements						HyMo		Specific pollutants				Artificial and HMWB			Chemical Status Class		Main Pressure			
River	**Water body code**	**Fish**	**Benthic invertebrates**	**Phytobenthos and Macrophytes**	**Phytoplankton**	**Overall Biological Status**	Confidence (Overall Biological Status)	**Hydromorphology - High Status (Y/N)**	**General Physical and Chemical conditions**	**Other WB Specific pollutants** (for Ecological Status Evaluation)	Confidence (Specific pollutants)	**OVERALL ECOLOGICAL STATUS**	Confidence class (Overall Ecol.Status)	**Artificial Water Body (Y/N)**	**HMWB (Y/N/Candidate (C))**	**Ecological Potential Class**	**CHEMICAL STATUS CLASS**	Confidence class (Chemical Status)	Organic Pollution	Nutrient Pollution	Hazardous Substances	Hydromorphological Alterations
Kupa/Kolpa	SI21VT50		1	3		3	L		2	2	H	3	L				2	H				
	DSRI020004							N	1**			2*	L	N	N		2*	L				
Kupa/Kolpa	SI21VT70		2	2		2	L		2	2	H	2	L				2	H				
Kupa/Kolpa	DSRN020002							N	1**			1*	L				3*	L			x	
Kupa/Kolpa	DSRN020001							N	1**			1*	L				3*	L			x	
Kupa/Kolpa	DSRN935009							N	1**			2*	L	N	N		2*	L				
Dobra	DSRN420001							N	1**			2*	L	N	N		2*	L				
Dobra	DSRN340001							N	1**			4*	L	N	N		3*	L			x	x
Dobra	DSRN020001							N	1**			1*	L	N	N		3*	L			x	
Korana	DSRI330004							N	1**			1*	L				2*	L				
	BA_KOR_1																					
Korana	DSRN330003							N	1**			1*	L	N	N		2*	L				
Korana	DSRN330002							N	1**			2*	L	N	N		2*	L				
Korana	DSRN330001							N	1**			1*	L	N	N		2*	L				
Glina	DSRN320006							N	2**			2*	L	N	N		2*	L				
Glina	DSRN320005							N	2**			2*	L	N	N		2*	L				
Glina	DSRN320004							N	2**			2*	L	N	N		2*	L				
Glina	DSRI320003							N	2**			2*	L	N	N		2*	L				
Glina	DSRN320002							N	2**			2*	L	N	N		2*	L				
Glina	DSRN320001							N	2**			2*	L	N	N		2*	L				

		Biological Quality Elements						HyMo		Specific pollutants				Artificial and HMWB			Chemical Status Class		Main Pressure			
River	**Water body code**	**Fish**	**Benthic invertebrates**	**Phytobenthos and Macrophytes**	**Phytoplankton**	**Overall Biological Status**	Confidence (Overall Biological Status)	**Hydromorphology - High Status (Y/N)**	**General Physical and Chemical conditions**	**Other WB Specific pollutants** (for Ecological Status Evaluation)	Confidence (Specific pollutants)	**OVERALL ECOLOGICAL STATUS**	Confidence class (Overall Ecol.Status)	**Artificial Water Body (Y/N)**	**HMWB (Y/N/Candidate (C))**	**Ecological Potential Class**	**CHEMICAL STATUS CLASS**	Confidence class (Chemical Status)	Organic Pollution	Nutrient Pollution	Hazardous Substances	Hydromorphological Alterations
SAVA	DSRN010005							N	2**			3*	L	N	C***		3*	L			x	x
SAVA	DSRI010004							N	2**			3*	L	N	C***		2*	L				x
	BA_SA_3		2		2	2	M	N	3	1	M	2	M	N	N		2	M				
Ilova	DSRN155046							N	2**			2*	L	N	N		2*	L				
Ilova	DSRN155020							N	2**			3*	L	N	C***		2*	L				x
Ilova	DSRN150001							N	3**			3*	L	N	C***		2*	L	x	x		
Una	BA_UNA_4											1	L	N	N		2	L				
	DSRI030004							N	1**			1*	L	N	N		2*	L				
Una	BA_UNA_3											2	L	N	N		2	L	R	R		
	DSRI030003							N	1**			1*	L	N	N		2*	L				
Una	BA_UNA_2		2		2	2	M	N	2	1	M	2	M	N	N		2	L		x		
	DSRI030002							N	2**			2*	L	N	N		2*	L				
Una	BA_UNA_1		2		2	2	M	N	2	3	M	3	M	N	N		2	M			x	
	DSRI030001							N	1**			2*	L	N	N		2*	L				
Sana	BA_UNA_SAN_5		3		2	3	M	N	2	1	M	3	M	N	N		2	M	x			
Sana	BA_UNA_SAN_4		3		2	3	M	N	2	1	M	3	M	N	N		2	M	x			
Sana	BA_UNA_SAN_3											2	L				2	L				
Sana	BA_UNA_SAN_2		2		2	2	M	N	3	1	M	2	M	N	N		2	M	x	x		
Sana	BA_UNA_SAN_1		2		2	2	M	N	3	1	M	2	M	N	N		2	M	x	x		
Lonja	DSRN160001							N	3**			3*	L	N	N		2*	L	x	x		

		Biological Quality Elements						HyMo		Specific pollutants				Artificial and HMWB			Chemical Status Class		Main Pressure			
River	Water body code	Fish	Benthic invertebrates	Phytobenthos and Macrophytes	Phytoplankton	Overall Biological Status	Confidence (Overall Biological Status)	Hydromorphology - High Status (Y/N)	General Physical and Chemical conditions	Other WB Specific pollutants (for Ecological Status Evaluation)	Confidence (Specific pollutants)	OVERALL ECOLOGICAL STATUS	Confidence class (Overall Ecol.Status)	Artificial Water Body (Y/N)	HMWB (Y/N/Candidate (C))	Ecological Potential Class	CHEMICAL STATUS CLASS	Confidence class (Chemical Status)	Organic Pollution	Nutrient Pollution	Hazardous Substances	Hydromorphological Alterations
Česma	DSRN165051							N	3**			3*	L	N	N		2*	L	x	x		
Česma	DSRN165034							N	3**			3*	L	N	C***		2*	L	x	x		x
Česma	DSRN165011							N	3**			3*	L	N	C***		2*	L	x	x		x
Glogovnica	DSRN165080							N	2**			2*	L	N	N		2*	L				
Glogovnica	DSRN165042							N	4**			4*	L	N	N		2*	L		x		x
Vrbas	BA_VRB_8											2	L				2	L				x
Vrbas	BA_VRB_7											3	L				3	L		x	x	
Vrbas	BA_VRB_6											3	L				2	L		x		
Vrbas	BA_VRB_5											1	L		Y		2	L				x
Vrbas	BA_VRB_4		3		2	3	L	N	2	1	L	3	L		Y		2	L	x	x		x
Vrbas	BA_VRB_3		3		2	3	M	N	2	1	M	3	M		Y	2	2	M	x			x
Vrbas	BA_VRB_2		3		2	3	M	N	2	1	M	3	M		N		2	M	x			x
Vrbas	BA_VRB_1		3		2	3	M	N	3	1	M	3	M		Y	3	2	M	x	x		x
Pliva	BA_VRB_PLIVA_4		3		2	3	M	N	2	1	M	3	M		N		2	M	x			
Pliva	BA_VRB_PLIVA_3		3		2	3	M	N	2	1	M	3	M		N		2	M	x			
Pliva	BA_VRB_PLIVA_2											2	L		Y		2	L				x
Pliva	BA_VRB_PLIVA_1											3	L				2	L		x		
Orliava	DSRN130003							N	1**			1*	L	N	N		2*	L				
Orliava	DSRN130002							N	2**			2*	L	N	N		2*	L				
Orliava	DSRN130001							N	3**			3*	L	N	N		2*	L	x	x		

		Biological Quality Elements						HyMo		Specific pollutants				Artificial and HMWB			Chemical Status Class		Main Pressure			
River	**Water body code**	**Fish**	**Benthic invertebrates**	**Phytobenthos and Macrophytes**	**Phytoplankton**	**Overall Biological Status**	Confidence (Overall Biological Status)	**Hydromorphology - High Status (Y/N)**	**General Physical and Chemical conditions**	**Other WB Specific pollutants** (for Ecological Status Evaluation)	Confidence (Specific pollutants)	**OVERALL ECOLOGICAL STATUS**	Confidence class (Overall Ecol.Status)	**Artificial Water Body (Y/N)**	**HMWB (Y/N/Candidate (C))**	**Ecological Potential Class**	**CHEMICAL STATUS CLASS**	Confidence class (Chemical Status)	Organic Pollution	Nutrient Pollution	Hazardous Substances	Hydromorphological Alterations
SAVA	DSRI010003							N	2**			4*	L	N	C***		2*	L				x
	BA_SA_2		3		2	3	M	N	3	1	M	3	M	N	C		2	M	x	x	x	X
SAVA	DSRI010002							N	2**			4*	L	N	C***		2*	L				x
SAVA	DSRI010001							N	2**			4*	L	N	C***		2*	L				x
	BA_SA_1		3		2	3	M	N	3	1	M	3	M	N	C		2	M	x	x	x	X
SAVA	RS_SA_3		3		2	3	M	N	2	3	M	3	M	N	C	2	3	M	x	x	x	X
Ukrina	BA_UKR_2		3		2	3	M	N	3	2	M	3	M	N	N		2	M	x	x		
Ukrina	BA_UKR_1		3		2	3	M	N	3	2	M	3	M	N	N		2	M	x	x		x
Bosna	BA_BOS_7											3	L				2	L	x	x		
Bosna	BA_BOS_6											3	L				2	L	x	x		
Bosna	BA_BOS_5											3	L				3	L	x	x	x	
Bosna	BA_BOS_4											3	L				3	L		x	x	
Bosna	BA_BOS_3											3	L				2	L		x		
Bosna	BA_BOS_2											3	L				2	L	x	x		
Bosna	BA_BOS_1		3		2	3	M	N	3	2	M	3	M	N	N		2	M	x	x	x	x
Lašva	BA_BOS_LAS_5											2	L				2	L				
Lašva	BA_BOS_LAS_4											2	L				2	L	x	x		
Lašva	BA_BOS_LAS_3											2	L				2	L				
Lašva	BA_BOS_LAS_2											2	L				2	L				
Lašva	BA_BOS_LAS_1											2	L				2	L				

		Biological Quality Elements						HyMo	General Physical and Chemical conditions	Specific pollutants		OVERALL ECOLOGICAL STATUS	Confidence class (Overall Ecol.Status)	Artificial and HMWB			Chemical Status Class		Main Pressure			
River	**Water body code**	**Fish**	**Benthic invertebrates**	**Phytobenthos and Macrophytes**	**Phytoplankton**	**Overall Biological Status**	Confidence (Overall Biological Status)	**Hydromorphology - High Status (Y/N)**		**Other WB Specific pollutants** (for Ecological Status Evaluation)	Confidence (Specific pollutants)			**Artificial Water Body (Y/N)**	**HMWB (Y/N/Candidate (C))**	**Ecological Potential Class**	**CHEMICAL STATUS CLASS**	Confidence class (Chemical Status)	Organic Pollution	Nutrient Pollution	Hazardous Substances	Hydromorphological Alterations
Tinja	BA_SA_TIN_4																					
Tinja	BA_SA_TIN_3																					
Tinja	BA_SA_TIN_2																					
Tinja	BA_SA_TIN_1																					
Krivaja	BA_BOS_KRI_4											3	L				2	L		x		
Krivaja	BA_BOS_KRI_3											2	L				2	L				
Krivaja	BA_BOS_KRI_2											2	L				2	L				
Krivaja	BA_BOS_KRI_1											1	L				2	L				
Spreča	BA_BOS_SPR_4																					
Spreča	BA_BOS_SPR_3											4	L				3	L	x	x	x	
Spreča	BA_BOS_SPR_2		3		2	3	L	N	3	3	M	3	L		Y		2	L	x	x		x
Spreča	BA_BOS_SPR_1		3		2	3	M	N	3	3	M	3	M	N	N		2	M	x	x	x	
Bosut	DSRN110005							N	3**			3*	L	Y	N		2*	L	x			
Bosut	DSRN110004							N	4**			4*	L	N	N		2*	L	x	x		
Bosut	DSRN110003							N	4**			4*	L	N	N		2*	L	x	x		
Bosut	DSRI110002							N	4**			4*	L	N	N		2*	L	x	x		
Bosut	DSRI110001							N	4**			4*	L	N	N		2*	L	x	x		
Bosut	RS_BOS		4		2	4	L	N	3			4	L	N	Y	2	3	L	x	x		x
Drina	BA_DR_7		3		2	3	M	N	3	1	M	3	M		N		2	M	x	x		x
Drina	BA_DR_6		2		2	2	L	N	3	1	M	3	L		C		2	L				x

		Biological Quality Elements						HyMo		Specific pollutants				Artificial and HMWB			Chemical Status Class		Main Pressure			
River	**Water body code**	**Fish**	**Benthic invertebrates**	**Phytobenthos and Macrophytes**	**Phytoplankton**	**Overall Biological Status**	Confidence (Overall Biological Status)	**Hydromorphology - High Status (Y/N)**	**General Physical and Chemical conditions**	**Other WB Specific pollutants** (for Ecological Status Evaluation)	Confidence (Specific pollutants)	**OVERALL ECOLOGICAL STATUS**	Confidence class (Overall Ecol.Status)	**Artificial Water Body (Y/N)**	**HMWB (Y/N/Candidate (C))**	**Ecological Potential Class**	**CHEMICAL STATUS CLASS**	Confidence class (Chemical Status)	Organic Pollution	Nutrient Pollution	Hazardous Substances	Hydromorphological Alterations
Drina	BA_DR_5		2		2	2	L	N	3	1	M	3	L		Y		2	L			x	x
Drina	BA_DR_4		2		2	2	M	N	3	1	M	2	M		Y	2	2	M	x			x
	RS_DR_4		3		3	2	L	N	2			3	L	N	Y	2	3	L	x	x		x
Drina	BA_DR_3		2		2	2	M	N	3	1	M	2	M		Y	2	2	M	x			x
	RS_DR_3		3		2	3	L	N	2			3	L	N	Y	2	2	L				x
Drina	BA_DR_2		2		2	2	M	N	3	1	M	2	M		Y	2	2	M	x			x
	RS_DR_2		3		2	3	L	N	2			3	L	N	Y	2	2	L		x		x
Drina	BA_DR_1		2		2	2	M	N	3	1	M	2	M		Y	2	3	L	x	x	x	x
	RS_DR_1		3		2	3	L	N	2			3	L	N	Y	2	2	L		x		x
Piva	ME_PIV_2											2	L				2	L	R			
Piva	ME_PIV_1											2	L				2	L	R			
Tara	ME_TAR_2											2	L				2	L	R			
Tara	ME_TAR_1											2	L				2	L	R			
	BA_DR_TAR_1		1		1	1	M	Y	2	1	M	1	M	N	N		2	M				
Ćehotina	ME_CECH_3											2	L				2	L				
Ćehotina	ME_CECH_2											3	L				3	L	P	P	P	R
Ćehotina	ME_CECH_1											3	L				3	L	R	P	P	R
Ćehotina	BA_DR_CECH_1		2		2	2	M	Y	3	1	M	2	M	N	N		3	M	x	x	x	
Prača	BA_DR_PRA_5		3		2	3	M	N	4	1	M	4	M	N	N		2	M	x	x		
Prača	BA_DR_PRA_4		3		2	3	L	N	4	1	M	4	L				2	L	x	x		

		Biological Quality Elements						HyMo		Specific pollutants				Artificial and HMWB			Chemical Status Class		Main Pressure			
River	**Water body code**	**Fish**	**Benthic invertebrates**	**Phytobenthos and Macrophytes**	**Phytoplankton**	**Overall Biological Status**	Confidence (Overall Biological Status)	**Hydromorphology - High Status (Y/N)**	**General Physical and Chemical conditions**	**Other WB Specific pollutants** (for Ecological Status Evaluation)	Confidence (Specific pollutants)	**OVERALL ECOLOGICAL STATUS**	Confidence class (Overall Ecol.Status)	**Artificial Water Body (Y/N)**	**HMWB (Y/N/Candidate (C))**	**Ecological Potential Class**	**CHEMICAL STATUS CLASS**	Confidence class (Chemical Status)	Organic Pollution	Nutrient Pollution	Hazardous Substances	Hydromorphological Alterations
Prača	BA_DR_PRA_3		2		2	2	L	N	1	1	M	2	L				2	L				
Prača	BA_DR_PRA_2		2		2	2	M	N	1	1	M	2	M	N	N		2	M				
Prača	BA_DR_PRA_1		2		2	2	M	N	1	1	M	2	M	N	N		2	M				
Lim	ME_LIM_1											2	L				2	L	R	R		R
Lim	ME_LIM_2											3	L				3	L	P	P	P	
Lim	RS_LIM_4		2	2		2	L	N				2	L	N	N		3	L	x		x	
Lim	RS_LIM_3		3	2		3	L	N	2			3	L	N	N		3	L	x		x	x
Lim	RS_LIM_2		3		2	3	L	N				3	L	N	Y	2	3	L	x			
Lim	RS_LIM_1		3	2		3	L	N	2			3	L	N	N		3	L	x		x	
	BA_LIM_1		3		2	3	M	N	3	1	M	3	M	N	N		2	M	x	x		
Uvac	RS_UV_7		2	2		2	L		2			2	L	N	N							
Uvac	RS_UV_6		3		2	3	L	N	2			3	L	N	Y	2			x			x
Uvac	RS_UV_5		4		2	4	L	N	2			4	L	N	Y	3			x	x		x
Uvac	RS_UV_4		3		2	3	L	N	2			3	L	N	Y	3			x	x		x
Uvac	RS_UV_3		3			3	L	N	2			3	L	N	N				x	x		x
Uvac	RS_UV_2		3			3	L		2			3	L	N	N				x	x		
Uvac	RS_UV_1		4	2		4	L	N	2			4	L	N	N		2	L	x			
	BA_DR_LIM_UVA_1											3	L				2	L	P	R	R	
Drinjača	BA_DRNJ_7											2	L				2	L	R	R	R	
Drinjača	BA_DRNJ_6											2	L				2	L	R	R	R	

		Biological Quality Elements						HyMo		Specific pollutants				Artificial and HMWB			Chemical Status Class		Main Pressure			
River	**Water body code**	**Fish**	**Benthic invertebrates**	**Phytobenthos and Macrophytes**	**Phytoplankton**	**Overall Biological Status**	Confidence (Overall Biological Status)	**Hydromorphology - High Status (Y/N)**	**General Physical and Chemical conditions**	**Other WB Specific pollutants** (for Ecological Status Evaluation)	Confidence (Specific pollutants)	**OVERALL ECOLOGICAL STATUS**	Confidence class (Overall Ecol.Status)	**Artificial Water Body (Y/N)**	**HMWB (Y/N/Candidate (C))**	**Ecological Potential Class**	**CHEMICAL STATUS CLASS**	Confidence class (Chemical Status)	Organic Pollution	Nutrient Pollution	Hazardous Substances	Hydromorphological Alterations
Drinjača	BA_DRNJ_5											2	L				2	L	R	R	R	
Drinjača	BA_DRNJ_4											2	L				2	L	R	R	R	
Drinjača	BA_DRNJ_3		2		2	2	M	N	3	1	M	2	M	N	N		2	M	x	x		
Drinjača	BA_DRNJ_2		2		2	2	M	N	3	1	M	2	M	N	N		2	M	x	x		
Drinjača	BA_DRNJ_1		2		2	2	M	N	3	1	M	2	M	N	N		2	M	x	x		
SAVA	RS_SA_2		3		2	3	M	N	2	3	M	3	M	N	N		3	M	x	x	x	x
SAVA	RS_SA_1		3	2	2	2	M	N	2	3	M	3	M	N	Y	2	3	M	x	x	x	x
Kolubara	RS_KOL_6		3	2		3	M	N	2			3	M	N	Y	2	2	M	x			x
Kolubara	RS_KOL_5		3	2		3	M	N	2			3	M	N	N		2	M	x			x
Kolubara	RS_KOL_4		3	2		3	M	N	3			3	M	N	N		3	M	x		x	x
Kolubara	RS_KOL_3		3	2		3	M	N	3			3	M	N	Y	2	3	M	x		x	x
Kolubara	RS_KOL_2		3	2		3	M	N	3			3	M	N	N		3	M	x		x	x
Kolubara	RS_KOL_1		4	2	2	3	M	N	3			4	M	N	Y	2	3	M	x	x	x	x

		Biological Quality Elements						HyMo		Specific pollutants				Artificial and HMWB			Chemical Status Class		Main Pressure			
River	Water body code	Fish	Benthic invertebrates	Phytobenthos and Macrophytes	Phytoplankton	Overall Biological Status	Confidence (Overall Biological Status)	Hydromorphology - High Status (Y/N)	General Physical and Chemical conditions	Other WB Specific pollutants (for Ecological Status Evaluation)	Confidence (Specific pollutants)	OVERALL ECOLOGICAL STATUS	Confidence class (Overall Ecol.Status)	Artificial Water Body (Y/N)	HMWB (Y/N/Candidate (C))	Ecological Potential Class	CHEMICAL STATUS CLASS	Confidence class (Chemical Status)	Organic Pollution	Nutrient Pollution	Hazardous Substances	Hydromorphological Alterations

Legend:

Ecological status assessment

Bad status (5)
Poor status (4)
Moderate status (3)
Good status (2)
High status (1)

* HR - the result corresponds to the lower of the two individual assessments (assessments of the general hydromorphological status and of the general physical-chemical status, obtained by modelling)

** Oxygenation condition (only BOD_5 and COD) and for nutrient conditions (total N and total P)

***Candidate for HMWB

Chemical status class

Failure to reach good chemical status (3)
Good chemical status (2)

For more detailed explanation of colour codes and numbers in the “Overall ecological status” and “Chemical status” see Background paper No.1.

Note:* In Croatia specific pollutants are included in the assessment of chemical status (obtained by modelling).

Main pressure

Y -at risk
P-possibly at risk
R- possibly not at risk
N-not at risk

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