COUNTRIES MAPS AND METADATA REPORT

Deliverable 3.1.1

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1. INTRODUCTION

WP3 provides the essential frame for WP4 and WP5 protocol-developing work packages. WP3 has two main objectives: (1) to describe the current status of and common needs for sediment quality monitoring in the DRB countries by compiling an inventory of good practices, national protocols, methods and databases related to sediment quality monitoring; and (2) to verify and demonstrate the integration and added value of surface water sediment quality monitoring by two pilot action for improving transnational water management.

The first objective, the inventory, as a handbook tool, describes existing good practices and the available knowledge in the DRB counties, and presents international examples for sediment quality monitoring. The inventory will ensure that the protocols that will be developed in the other work packages (WP4 and WP5) will be based on the best available knowledge. This tool will contribute to build a “common knowledge on current status of HS sediment monitoring in DRB (SO1)”.

In this activity SIMONA partners collected information in the DTP countries: legislative frameworks, experiences, practices, technical procedures, existing sampling, laboratory and evaluation methods, existing water body monitoring and sampling sites, existing methodologies of surface water chemical status assessment (e.g. spatial and temporal aggregation techniques of HSs concentrations, limit values for the national River Basin Specific Pollutants, the natural background levels corrections for metals, in addition to metadata related to sediment quality monitoring, analysis and assessment). This activity used a commonly agreed questionnaire in order to ensure transparency and comparability of information among the countries. The activity included, but was not limited to, the identification of problems of the current monitoring procedures in DRB, the review of the sediment monitoring network status, data and metadata availability, and the inventory of sampling and laboratory methodologies. The delivered ‘Inventory’ report contains all the questionnaire information, including the availability of DTP counties' relevant technological capacities and resources. This information sets the basis and directions for all the SIMONA protocols development (WP4, WP5 and WP6).

The inventory report was focused on the peculiarities of the aquatic environment, more precisely on the river sediments, as this information together with the ones existing at the international level will be the basis for the elaboration of the "Guide

for Danube River sediment quality monitoring". The data collection was based on a questionnaire proposed by the RO-IGR partner in November 2018, debated and improved by partners.
Its final form (Annex 1) was completed by all 14 project partners (Annexes 2-15). Information from partner institutions of SIMONA countries was inventoried to extract similar and effective methodologies for testing, identifying relevant hazardous substances, analyzing them, establishing ecosystem quality classes based on selected criteria, and non-common methodologies that can be taken over by other partners, and could be implemented to develop the unitary guide for sediments.

2. SIMONA COUNTRIES' ANALYSIS

Each country answered the questionnaire, the contributors being listed in Table 1.

Table 1 – List of contributors in project countries

Country	Institution(s) which filled the inventory questionnaire	Link
Austria (AT)	Geological Survey of Austria Austrian Institute of Technology Environment Agency of Austria	https://www.geologie.ac.at/ https://www.ait.ac.at/ http://www.umweltbundesamt.at/en/
Bulgaria (BG)	Ministry of Environment and Water (MOEW) Executive Environment Agency (ExEA) Basin Directorate Danube Region (BDDR)	https://www.moew.government.bg/en/ http://eea.government.bg/en http://www.bd-dunav.org/
Bosnia and Herzegovina – Federation of Bosnia and Herzegovina (BA)	Federal Institute for Agropedology Federal Institute for Agriculture Sava River Basin Agency	http://www.fbihvlada.gov.ba/english/uprave_v2/agropedologija.php http://www.fbihvlada.gov.ba/english/uprave_v2/poljoprivreda.php http://www.voda.ba/
Bosnia and Herzegovina - Srpska Republic (BA-SRP)	Javna ustanova "Vode Srpske" (water management public authority)	http://www.voders.org/
Croatia (HR)	Croatian Geological Survey, Hrvatske vode (Water management public authority) Ministry of Environment and Energy	http://www.hgi-cgs.hr/eng/ https://www.voda.hr/ https://www.mzoip.hr/en/
Germania (DE)	Bavarian Environment Agency	https://www.lfu.bayern.de/index.htm
Hungary (HU)	NARIC (National Agricultural Research and Innovation Centre) OVF (General Directorate of Water Management)	https://www.naik.hu/en/organizations/national-agricultural-research-and-innovation-centre http://www.ovf.hu/en/
Republic of Moldova (MD)	Institute of Geology and Seismology Ministry of Agriculture, Regional Development and Environment	http://igs.asm.md/en www.mcdr.gov.md

Country	Institution(s) which filled the inventory questionnaire	Link
Montenegro (ME)	Geological Survey of Montenegro Agency for Nature and Environment Protection of Montenegro Institute of Hydrometeorology and Seismology of Montenegro	http://geozavod.co.me/en/home/ http://www.mrt.gov.me/en/organization/environment http://www.meteo.co.me/
Romania (RO)	Tehnical University of Cluj Napoca Geological Institute of Romania National Administration Romanian Waters	https://www.utcluj.ro/ http://www.igr.ro/ http://www.rowater.ro/default.aspx
Serbia (RS)	Institute for Development of Water Resources "Jaroslav Černi" Ministry of Environmental Protection of the Republic of Serbia Serbian Environmental Protection Agency	http://www.see-river.net/ijc-serbija.html http://www.ekologija.gov.rs/ http://www.sepa.gov.rs/index.php
Slovakia (SK)	State Geological Institute of Dioniyz Stur	https://www.geology.sk/
Slovenia (SI)	Geological Survey of Slovenia (GeoZS) Slovenia Ministry of the environment and spatial planning - Slovenian Environment Agency (MOP-ARSO)	http://www.geo-zs.si/index.php/en/ http://www.mop.gov.si/en/
Ukraine (UA)	State Enterprise "Ukrainian Geological Company"	https://ukrgeol.com/ua/

I. LEGISLATIVE FRAMEWORK

The answers of this part (I) of the questionnaire were structured into tables related to:

- Legislation for river water, drinking water, waste water, air, soils and sediments;
- Definitions in partner countries of maximum and normal levels for major and trace elements in river water, drinking water, waste water, air, soils and sediments;
- Lists of maximum and normal levels in partner countries for major and trace elements in river water, drinking water, soils and river sediments;
- Comparison lists of values in national legislations of some partner countries versus other sediment quality guides;
- Lists of ISO standards used for sampling, transport, storage and analysis of soil, water, air and biota.

I.1. National or/and European legislation

This chapter implied the enumeration of national or European legislation (laws, governmental orders, and emergency ordinances) that regulates the concentrations of dangerous substances posing a risk to the health of the population or aquatic life, in soils, surface waters, drinking water, river sediments, marine sediments, sewage, therapeutic sludge, air and biota.

The analysis of the legislation listed in the questionnaires (Annexes 2 – 15) revealed that each country has laws and norms for water (river, drinking, waste), air and soil. In most of the cases, these are specific regulations. In few cases they are included in general environmental laws.
Regarding sediments, only Slovakia and Serbia have specific legislation, while for Romania and Slovenia some previsions regarding sediments are included in the laws referring to water.

Table 2 – List of legislation related to drinking water

Country acronym	National, EU, international legislation related to drinking water		Link
	Title (national language)	Title (in English)	
AT	Trinkwasser-verordnung	Quality Ordinance for Drinking water	https://www.ris.bka.gv.at/Dokumente/BgblAuth/BGBLA_2017_II_362/BGBLA_2017_II_362.pdfsig
BA	("Službeni glasnik Bosne i Hercegovine" broj 40/10, 43/10, 30/12) "Pravilnik o zdravstvenoj ispravnosti vode za piće"	("Official Gazette of Bosnia and Herzegovina" No 40/10, 43/10, 30/12) „Ordinance on the health of drinking water"	http://www.fsa.gov.ba/fsa/images/pravni-propisi/hr-Pravilnik_o_zdravstvenoj_ispravnosti_vode_za_pi%C4%87e_40-10.pdf
BA-SRP	Pravilnik o zdrastvenoj ispravnosti vode namijenjene za ljudsku potrošnju („Službeni glasnik Republike Srpske", broj 88/17)	Ordinance on drinking water health quality for human use(„Official Gazette Republika Srpska", no 88/17)	http://www.vladars.net/sr-SP-Cyrl/Vlada/Ministarstva/MZSZ/Documents/%D0%9F%D1%80%D0%B0%D0%B2%D0%B8%D0%BB%D0%BD%D0%B8%D0%BA%20%D0%BE%20%D0%B7%D0%B4%D1%80%D0%B0%D0%B2%D1%81%D1%82%D0%B2%D0%B5%D0%BD%D0%BE%D1%98%20%D0%B8%D1%81%D0%BF%D1%80%D0%B0%D0%B2%D0%BD%D0%BE%D1%81%D1%82%D0%B8%20%D0%B2%D0%BE%D0%B4%D0%B5%20%D0%B7%D0%B0%20%D0%BF%D0%B8%D1%9B%D0%B5.pdf
BG	Наредба № 9 от 16.03.2001 г. за качеството на водата, предназначена за питейно-битови цели	Regulation №9 from 16.03.2001 for the quality of drinking water	https://www.moew.government.bg/static/media/ups/tiny/filebase/Water/Legislation/Naredbi/vodi/Naredba_9.pdf
HR	Pravilnik o zdravstvenoj ispravnosti vode za piće	Directive on the quality of water intended for human consumption	https://narodne-novine.nn.hr/clanci/sluzbeni/2008_04_47_1593.html

Country acronym	National, EU, international legislation related to drinking water		Link
	Title (national language)	Title (in English)	
			http://www.voda.hr/sites/default/files/council_directive_98-83-ec.pdf
DE	-	-	-
HU	201/2001. (X. 25.) Korm. rendelet az ivóvíz minőségi követelményeiről és az ellenőrzés rendjéről	201/2001. (X. 25.) on the quality requirements of drinking water and the order of control	https://net.jogtar.hu/jogszabaly?docid=A0100201.KOR
MD	HOTĂRÎRE Guvernului Nr. 934 din 15.08.2007 cu privire la instituirea Sistemului informaţional automatizat „Registrul de stat al apelor minerale naturale, potabile şi băuturilor nealcoolice îmbuteliate”	GOVERNMENT DECISION Nr. 934 from 15.08.2007 on the establishment of the Automated Information System "State Register of natural mineral and potable waters, and bottled non-alcoholic beverages"	http://lex.justice.md/md/325013 http://www.amac.md/Biblioteca/data/30/02/04.1.pdf

Country acronym	National, EU, international legislation related to drinking water		Link
	Title (national language)	Title (in English)	
ME	Pravilnik o higijenskoj ispravnosti vode za piće ("Sl. list SRJ", br. 42/98 i 44/99) Pravilnik o parametrima, provjeri usaglašenosti, metodama, načinu, obimu analiza I sprovođenju monitoring zdravstvene ispravnosti vode za ljudsku upotrebu (Sl.list Crne Gore, br.64/2018)	Regulations on hygiene direction of drinking water (Official Gazette of FRY", No. 42/98 and 44/99) Ordinance on parameters, conformity assessment, methods, method, scope of analysis and implementation of health monitoring of water for human consumption (Official Gazette of Montenegro, No.64 / 2018)	https://www.tehnologijahrane.com/pravilnik/pravilnik-o-higijenskoj-ispravnosti-vode-i
RO	Legea nr. 311 din 28/06/2004 privind calitatea apei potabile	Law no. 311 of 28/06/2004 on the quality of drinking water	http://legislatie.just.ro/Public/DetaliiDocument/53106 http://legislatie.just.ro/Public/FormaPrintabila/00000G290A50GQCZXGG1FNY252MXXQQS
RS	Pravilnik o higijenskoj ispravnosti vode za piće	Rulebook on the quality of water intended for human consumption	http://www.zjz.org.rs/wp-content/uploads/2013/04/pravilnik-o-higijenskoj-ispravnosti-vode-za-pice.pdf
SK	Decree No. 247/2017 -	Decree No. 247/2017 Coll. Decree of the Ministry of Health of the Slovak Republic drinking water quality control, monitoring and risk management of drinking water	https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2017/247/20171015

Country acronym	National, EU, international legislation related to drinking water		Link
	Title (national language)	Title (in English)	
SI	Pravilnik o pitni vodi (Uradni list RS, št. 19/04, 35/04, 26/06, 92/06, 25/09, 74/15 in 51/17)	Rules on Drinking Water (Official Gazette of RS, Nos. 19/04 , 35/04 , 26/06 , 92/06 , 25/09 , 74/15 and 51/17)	http://pisrs.si/Pis.web/pregledPredpisa?id=PRAV3713
UA	ДСанПіН 2.2.4-171-10 Гігієнічні вимоги до води питної, призначеної для споживання людиною Наказ МОЗ України № 400 від 12.05.10	State SanPin 2.2.4-171-10 Hygienic requirements for drinking water intended for human consumption Order of the Ministry of Health of Ukraine No. 400 dated May 12, 10	http://www.studmed.ru/download/dsanpn-224-171-10-ggyenchn-vimogi-do-vodi-pitnoyi-priznachenoyi-dlya-spozhivannya-lyudinoyu_384bdcbfb6c.html
	ДСТУ 4808:2007. Джерела централізованого питного водопостачання. Гігієнічні та екологічні вимоги щодо якості води і правила вибирання	DSTU 4808: 2007 Sources of centralized drinking water supply. Hygienic and environmental requirements for water quality and selection rules	http://library.dstu.education/indexing.php?r2=108175

"Surface waters" mean above-ground open fresh or brackish waterbodies (e.g. rivers, streams, lakes and pools, springs), including their littoral zones. They includes constructed inland freshwater, brackish or saline waterbodies (such as canals, ponds, etc.) which support a semi-natural community of both plants and animals; seasonal waterbodies which may dry out for part of the year (temporary or intermittent rivers and lakes and their littoral zones). Freshwater littoral zones include those parts of banks or shores that are sufficiently and frequently inundated to prevent the formation of closed terrestrial vegetation.

Table 3 - List of legislation related to surface and groundwater

Country acronym	National, EU, international legislation related to surface and groundwater water		Link
	Title (national language)	**Title (in English)**	
AT	Qualitätsziel-verordnung Chemie Grundwasser + Oberflächen-gewässer + Ökologie Oberflächen-gewässer	Quality Ordinance for the Chemistry of Groundwater and the Chemistry and Ecology of Surface Water	https://www.ris.bka.gv.at/Dokumente/BgblAuth/BGBLA_2016_II_363/BGBLA_2016_II_363.pdfsig
BA	("Službeni glasnik Bosne i Hercegovine" broj 26/10) "Pravilnik o prirodnim mineralnim i prirodnim izvorskim vodama"	("Official Gazette of Bosnia and Herzegovina" No 26/10) „Ordinance on natural mineral and natural spring waters"	http://www.fsa.gov.ba/fsa/images/pravni-propisi/bs-Pravilnik_o_prirodnim_mineralnim_i_prirodnim_izvorskim_vodama_26-10.pdf
BA	("Službeni glasnik Bosne i Hercegovine" broj 26/10) "Pravilnik o prirodnim mineralnim I prirodnim izvorskim vodama"	("Official Gazette of Bosnia and Herzegovina" No 26/10) „Ordinance on natural mineral and natural spring waters"	http://www.fsa.gov.ba/fsa/images/pravni-propisi/bs-Pravilnik_o_prirodnim_mineralnim_i_prirodnim_izvorskim_vodama_26-10.pdf
BA	("Službene novine Federacije BiH" broj 70/06) "Zakon o vodama"	("Official Newspapers of Federation of B&H" No 70/06) "Water Law"	http://www.voda.ba/zakoni/47bos.pdf
BA-SRP	Pravilnik o uslovima ispuštanja otpadnih voda u površinske vode („Sl. glasnik RS" broj 44/01)	Rulebook on conditions for discharging wastewater into surface waters ("Official Gazette of RS", 44/01)	http://www.voders.org/images/PDF/pravilnici/Pravilnik_ispustanje-povrs-vode_44_01.pdf?lang=lat

Country acronym	National, EU, international legislation related to surface and groundwater water		Link
	Title (national language)	Title (in English)	
	Uredba o klasifikaciji voda i kategoriyaciji vodotoka	Regulation on water classification and categorization of water courses (Official Gazette of Republika Srpska 41/01)	http://www.voders.org/images/PDF/uredbe/uredba_o_klasifikaciji_vodotoka.pdf?lang=lat
BG	Закон за водите	Water law	https://www.moew.government.bg/bg/vodi/zakonodatelstvo/zakoni/
	Наредба № Н-4 от 14.09.2012 г. за характеризиране на повърхностните води	Regulation №4 14.09.2012 for characteristics of the surface waters	https://www.moew.government.bg/bg/vodi/zakonodatelstvo/naredbi/
	Наредба № 1 от 11.04.2011 г. за мониторинг на водите	Regulation №1 11.04.2011 for water monitoring	https://www.moew.government.bg/bg/vodi/zakonodatelstvo/naredbi/
HR	Uredba o opasnim tvarima u vodama	Regulation on hazardous substances in water	https://narodne-novine.nn.hr/clanci/sluzbeni/2015_07_78_1504.html https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013L0039&from=EN
DE	Oberflächengewässerverordnung vom 20.06.2016	German Directive for the protection of surface waters as of 20.06.2016	https://www.gesetze-im-internet.de/ogewv_2016/OGewV.pdf
HU	10/2010. (VIII. 18.) VM rendelet a felszíni víz vízszennyezettségi határértékeiről és azok alkalmazásának szabályairól	Environmental quality standards and other thresholds for Surface waters and the usage of these limit values	https://net.jogtar.hu/getpdf?docid=a1000010.vm&targetdate=&printTitle=10/2010.+%28VIII.+18.%29+VM+rendelet
	219/2004. (VII. 21.) Korm. rendelet a felszín alatti vizek védelméről	219/2004. (VII. 21.) on the protection of groundwater	https://net.jogtar.hu/jogszabaly?docid=A0400219.KOR

Country acronym	National, EU, international legislation related to surface and groundwater water		Link
	Title (national language)	**Title (in English)**	
	Törvény a vízgazdálkodásról (ill. a 2001. évi LXXI. törvény az előbbi módosításáról)	Act on Water Management (or Amendment to Act LXXI of 2001)	1995. évi LVII. törvény a vízgazdálkodásról (ill. a 2001. évi LXXI. törvény az előbbi módosításáról)
	Az Európai Parlament és a Tanács 2000. október 23-i 2000/60/EK irányelve a vízvédelmi politika terén a közösségi fellépés kereteinek meghatározásáról	Directive 2000/60 / EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy \ t	Az Európai Parlament és a Tanács 2000. október 23-i 2000/60/EK irányelve a vízvédelmi politika terén a közösségi fellépés kereteinek meghatározásáról
	Korm. rendelet a Duna védelmére és fenntartható használatára irányuló együttműködésről szóló, 1994. június 29-én, Szófiában létrehozott Egyezmény kihirdetéséről	On the promulgation of the Convention on Cooperation for the Protection and Sustainable Use of the Danube established in Sofia on 29 June 1994	74/2000. (V. 31.) Korm. rendelet a Duna védelmére és fenntartható használatára irányuló együttműködésről szóló, 1994. június 29-én, Szófiában létrehozott Egyezmény kihirdetéséről
MD	HOTĂRÎREA Guvernului Nr 890 din 12.11.2013 pentru aprobarea „Regulamentului cu privire la cerinţele de calitate a mediului pentru apele de suprafaţă”.	GOVERNMENT DECISION Nr. 890 from 12.11.2013 for the approval of the “Regulation on Environmental Requirements for Surface Waters”	http://www.justice.gov.md/file/Centrul%20de%20armonizare%20a%20legislatiei/Baza%20de%20date/Materiale%202013/Acte/PNAL/HG_890_din_12.11.13.pdf http://www.justice.gov.md/file/Centrul%20de%20armonizare%20a%20legislatiei/Baza%20de%20date/Materiale%202013/Acte/PNAL/HG_890_din_12.11.13.pdf

Country acronym	National, EU, international legislation related to surface and groundwater water		Link
	Title (national language)	Title (in English)	
	HOTĂRÎREA Guvernului Nr.932 pentru aprobarea Regulamentului privind monitorizarea şi evidenţa sistematică a stării apelor de suprafaţă şi a apelor subterane	GOVERNMENT DECISION Nr. 932 for the approval of the "Regulation on the monitoring and systematic evidence of the status of surface waters and groundwater"	http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=350467 http://www.amac.md/Biblioteca/data/30/02/30.1.pdf
ME	Uredba o klasifikaciji i kategorizaciji površinskih voda u Crnoj Gori (Sl. i.27/07)	Regulation on Classification and Categorization of surface water and Groundwater in Montenegro (Official Gazette of Montenegro 27/07)	https://www.morskodobro.com/dokumenti/uredba_klasifikacija_kategorizacija_podzemnih_voda.pdf
RO	Ordin nr. 161 din 16/02/2006 pentru aprobarea Normativului privind clasificarea calitatii apelor de suprafata in vederea stabilirii starii ecologice a corpurilor de apa	Order no. 161 of 16/02/2006 for the approval of the Normative on the Classification of Surface Water Quality to establish the ecological status of the water bodies	http://www.rowater.ro/dacrisuri/Documente%20Repository/Legislatie/gospodarirea%20apelor/ORD.%20161_16.02.2006.pdf
SK	Nariadenie vlády Slovenskej republiky č. 269/2010 z 25. mája 2010, ktorým sa ustanovujú požiadavky na dosiahnutie dobrého stavu vôd	Regulation of the Government of the Slovak Republic no. 269/2010 of 25 May 2010 laying down requirements for achieving good water status	https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2010/269/
	Nariadenie vlády Slovenskej republiky č. 270/2010	Regulation of the Government of the Slovak Republic no. 270/2010	https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2010/270/vyhlasene_znenie.html

Country acronym	National, EU, international legislation related to surface and groundwater water		Link
	Title (national language)	**Title (in English)**	
	z 25. mája 2010 o environmentálnych normách kvality v oblasti vodnej politiky	of 25 May 2010 on environmental quality standards in water policy	
SI	Uredba o stanju površinskih voda (Uradni list RS, št. 14/09, 98/10, 96/13 in 24/16)	Decree on the status of surface waters (Official Gazette of RS, Nos. 14/09 , 98/10 , 96/13 and 24/16)	http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED5010#
	Uredba o kakovosti površinskih voda za življenje sladkovodnih vrst rib (Uradni list RS, št. 46/02 in 41/04 – ZVO-1)	Decree on the quality required of surface waters supporting fresh-water fish life (Official Gazette of RS, Nos. 46/02 and 41/04 - ZVO-1)	http://pisrs.si/Pis.web/pregledPredpisa?id=URED2401
	Pravilnik o monitoringu stanja površinskih voda (Uradni list RS, št. 10/09, 81/11 in 73/16)	Rules on the monitoring of surface waters (Official Gazette of RS, Nos. 10/09 , 81/11 and 73/16)	http://pisrs.si/Pis.web/pregledPredpisa?id=PRAV9315
	Pravilnik o določitvi in razvrstitvi vodnih teles površinskih voda (Uradni list RS, št. 63/05, 26/06, 32/11 in 8/18)	Rules on the designation and classification of surface water bodies (Official Gazette of RS, Nos. 63/05 , 26/06 , 32/11 and 8/18)	http://pisrs.si/Pis.web/pregledPredpisa?id=PRAV6946
	Strategija preprečevanja kemijskega onesnaženja površinskih voda	Strategies against chemical pollution of surface waters	http://ec.europa.eu/environment/water/water-dangersub/index.htm

Country acronym	National, EU, international legislation related to surface and groundwater water		Link
	Title (national language)	**Title (in English)**	
	Pravilnik o monitoringu kakovosti površinske vode za življenje in rast morskih školjk in morskih polžev (Uradni list RS, št. 71/02 in 41/04 – ZVO-1)	Rules on the monitoring of surface water quality for the life and growth of marine bivalves and gastropods (Official Gazette of RS, Nos. 71/02 and 41/04 - ZVO-1)	http://pisrs.si/Pis.web/pregledPredpisa?id=PRAV4293
SR	Pravilnik o parametrima ekološkog i hemijskog statusa površinskih voda i parametrima hemijskog i kvantitativnog statusa podzemnih voda	Rulebook on the parameters of ecological and chemical status of surface waters and parameters of chemical and quantitative status of groundwater	http://www.rdvode.gov.rs/doc/dokumenta/podzak/Pravilnik%20o%20parametrima%20ekoloskog%20i%20hemijskog%20statusa%20povrsinskih%20voda%20i%20parametrima%20hemijskog%20i%20kvantitativnog%20statusa%20podzemnih%20voda.pdf
	Uredba o graničnim vrednostima zagađujućih materija u površinskim i podzemnim vodama i sedimentu i rokovima za njihovo dostizanje	Regulation on limit values of polluting substances in surface and groundwaters and deadlines for their achievement	http://www.sepa.gov.rs/download/kvbg/uredba2.pdf
	Uredba o graničnim vrednostima prioritetnih i prioritetnih hazardnih supstanci koje zagađuju površinske vode i rokovima za njihovo dostizanje	Regulation on limit values of priority and hazardous substances in surface waters and deadlines for their achievement	http://www.sepa.gov.rs/download/kvbg/uredba3.pdf

Country acronym	National, EU, international legislation related to surface and groundwater water		Link
	Title (national language)	Title (in English)	
	Uredba o graničnim vrednostima emisija zagađujućih materija u vode i rokovima za njihovo dostizanje	Regulation on the limit values for emissions of polluting substances into waters and the deadlines for their achievement	http://www.rdvode.gov.rs/doc/dokumenta/podzak/Uredba%20o%20granicnim%20vrednostima%20emisije%20zagadjujucih%20materija%20u%20vode%20i%20rokovima%20za%20njihovo%20dostizanje.pdf
UA	-	-	-

Table 4 – List of legislation related to waste water

Country acronym	National, EU or international legislation related to waste (sewage) water		Link
	Title (national language)	Title (in English)	
AT	Abwasser-emissions-verordnung	Ordinance for Emission of Sewage water	https://www.ris.bka.gv.at/GeltendeFassung/Bundesnormen/10010977/AAEV%2c%20Fassung%20vom%2005.11.2018.pdf
BA	("Službene novine Federacije BiH" broj 4/12) "Uredba o uvjetima ispuštanja otpadnih voda u prirodne recipijente I sustav javne kanalizacije"	("Official Newspapers of Federation of B&H" No 4/12) "Regulation on Conditions for Discharging Wastewater into Natural Recipients and Public sewer system"	http://www.fuzip.gov.ba/bundles/websitenews/gallery/files/117/149725598230_Uredba_o_uslovima_ispu%C5%A1tanja_otpadnih_voda_u_okoli%C5%A1_i_sisteme_javne_kanalizacije_(_Slu%C5%BEbene_novine_FBiH_,_broj__101_15).pdf

Country acronym	National, EU or international legislation related to waste (sewage) water		Link
	Title (national language)	Title (in English)	
	(“Službene novine Federacije BiH” broj 50/07) “Pravilnik o graničnim vrijednostima opasnih I štetnih materija za tehnološke otpadne vode prije njihovog ispuštanja u system javne kanalizacije, odnosno drugi prijemnik”	(“Official Newspapers of Federation of B&H” No 50/07) "Ordinance on Limits of Hazardous and Noxious Substances for Technological Waste Water Prior to Their Discharge into the Public Sewerage System, i.e. another Receiver"	http://www.voda.ba/zakoni/25_56_b.pdf
BA-SRP	Pravilnik o uslovima za ispuštanje otpadnih voda u javnu kanalizaciju (Službeni glasnik Republike Srpske broj 44/01)	Regulations on the terms of release wastewater into the public sewerage system (“Official Gazette of RS”, No. 44/01)	http://www.vladars.net/sr-SP-Cyrl/Vlada/Ministarstva/mps/Documents/Pravilnik_o_uslovima_za_ispustanje_otpadnih_voda_u_javnu_kanalizaciju_44_2001.pdf
	Pravilnik o tretmanu I odvodnji otpadnih voda za područje gradova I naselja gdje nema javne kanalizacije (Službeni glasnik Republike Srpske broj 68/01)	Rulebook on treatment and waste water disposal in the cities and towns where there is no public sewage system (”Official Gazette of RS”, 68/01)	http://www.voders.org/images/PDF/pravilnici/Pravilnik_o_odvodnji_otpadnih_gde_nema_javnkanalizacij_PRAVI.pdf?lang=lat
BG	-	-	-
HR	Pravilnik o graničnim vrijednostima emisija otpadnih voda	Ordinance on threshold values for waste water emissions	https://narodne-novine.nn.hr/clanci/sluzbeni/2013_06_80_1681.html
DE	-	-	-

Country acronym	National, EU or international legislation related to waste (sewage) water		Link
	Title (national language)	Title (in English)	
HU	58/2013. (II. 27.) Korm. rendelet a víziközmű-szolgáltatásról szóló 2011. évi CCIX. törvény egyes rendelkezéseinek végrehajtásáról	58/2013. (II. 27.) on the implementation of certain provisions of Act CCIX 2011 on Water Utility Services	https://net.jogtar.hu/jogszabaly?docid=A1300058.KOR
	455/2013. (XI. 29.) Korm. rendelet a nem közművel összegyűjtött háztartási szennyvíz begyűjtésére vonatkozó közszolgáltatási tevékenység részletes szabályairól	455/2013. (XI. 29.) on the detailed rules of public service activities for the collection of non-public household waste water	https://net.jogtar.hu/jogszabaly?docid=A1300455.KOR
MD	HOTĂRÎRE Guvernului Nr.950 din 25.11.2013 pentru aprobarea Regulamentului privind cerinţele de colectare, epurare şi deversare a apelor uzate în sistemul de canalizare şi/sau în corpuri de apă pentru localităţile urbane şi rurale	GOVERNMENT DECISION Nr. 950 from 25.11.2013 for the approval of the "Regulation for the collection, treatment and discharging of waste water into sewerage systems and / or water bodies for urban and rural localities"	http://lex.justice.md/md/350537/ http://www.amac.md/Biblioteca/data/30/02/08.1.pdf http://www.amac.md/Buletine/Buletin_10.pdf
ME	-	-	-
RO	HG 352/2005, privind modificarea şi completarea Hotărârii Guvernului nr.	GD 352/2005, on the modification and completion of the Government Decision no. 188/2002 approving some norms	-

Country acronym	National, EU or international legislation related to waste (sewage) water		Link
	Title (national language)	Title (in English)	
	188/2002 pentru aprobarea unor norme privind condiţiile de descărcare în mediul acvatic a apelor uzate . Directiva 2008/98/CE a Parlamentului European şi a Consiliului din 19 noiembrie 2008 privind deşeurile şi de abrogare a anumitor directive	regarding the discharge conditions in the aquatic environment of the waste waters Directive 2008/98 / EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives.	
SK	Zákon č. 364/2004 z 13. mája 2004 o vodách a o zmene zákona Slovenskej národnej rady č. 372/1990 Zb. o priestupkoch v znení neskorších predpisov (vodný zákon)	Act no. 364/2004 of 13 May 2004 on waters and amending Act of the Slovak National Council no. 372/1990 Coll. on offenses as amended (Water Act)	https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2004/364/20150115
SI	Uredba o emisiji snovi in toplote pri odvajanju odpadnih voda v vode in javno kanalizacijo (Uradni list RS, št. 64/12, 64/14 in 98/15)	Decree on the emission of heat in the discharge of wastewater into public sewers and water (Official Gazette of RS, Nos. 64/12 , 64/14 and 98/15)	http://pisrs.si/Pis.web/pregledPredpisa?id=URED6070

Table 5 – List of legislation related to air

Country acronym	National, EU or international legislation related to air		Link
	Title (national language)	Title (in English)	
AT	Immissions-schutzgesetz – Luft	Air Pollution Control Act	http://www.ris.bka.gv.at/GeltendeFassung/Bundesnormen/10011027/IG-L%2c%20Fassung%20vom%2008.11.2018.pdf
BA	("Službene novine Federacije BiH" broj 33/03) "Zakon o zaštiti zraka "	("Official Newspapers of Federation of B&H" No 33/03)	http://www.fzofbih.org.ba/userfiles/file/Zakon%20o%20zastiti%20zraka.pdf
		"Law on Air Protection"	
BA-SRP	Zakon o zaštiti vazduha (Službeni glasnik Republike Srpske broj 124/11, 46/17)	Law on air (Official Gazette of Republic of Srpska 124/11, 46/17)	http://www.narodnaskupstinars.net/?q=la/akti/usvojeni-zakoni/zakon-o-za%C5%A1titi-vazduh
BG	-	-	-
HR	Uredba o razinama onečišćujućih tvari u zraku	Regulation on levels of pollutants in the air	https://narodne-novine.nn.hr/clanci/sluzbeni/2012_10_117_2521.html
	Uredba o graničnim vrijednostima emisija onečišćujućih tvari u zrak iz nepokretnih izvora	Regulation on emission limit values for pollutants in air from immovable sources	https://narodne-novine.nn.hr/clanci/sluzbeni/2017_08_87_2073.html https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0050&from=EN, https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:023:0003:0016:EN:PDF https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:334:0017:0119:EN:PDF
DE	-	-	-
HU	-	-	-
MD	-	-	-
ME	-	-	-
RO	-	-	-

Country acronym	National, EU or international legislation related to air		Link
	Title (national language)	Title (in English)	
RS	Uredba o merenjima emisija zagađujućih materija u vazduh iz stacionarnih izvora zagađivanja	Regulation on the measurement of emissions from stationary pollution sources into air	https://www.paragraf.rs/propisi/uredba_o_merenjima_emisija_zagadjujucih_materija_u_vazduh_iz_stacionarnih_izvora_zagadjivanja.html
	Uredba o graničnim vrednostima emisija zagađujućih materija u vazduh iz postrojenja za sagorevanje	Regulation on the emission of pollutants into the air from combustion plants	http://www.pravno-informacioni-sistem.rs/SlGlasnikPortal/eli/rep/sgrs/vlada/uredba/2016/6/1/reg
	Uredba o graničnim vrednostima emisija zagađujućih materija u vazduh iz stacionarnih izvora zagađivanja, osim postrojenja za sagorevanje	Regulation on the limit values of emissions from stationary pollution sources, other than combustion plants, into air.	http://www.pravno-informacioni-sistem.rs/SlGlasnikPortal/eli/rep/sgrs/vlada/uredba/2015/111/1/reg
SK	Zákon č. 137/2010 z 3. marca 2010 o ovzduší	Act no. 137/2010 of 3 March 2010 about air	https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2010/137/
SI	-	-	-
UA	Державні санітарні правила охорони атмосферного повітря населених місць (від забруднення хімічними та біологічними речовинами). Наказ МОЗ України № 201 від 09.07.97	State sanitary regulationsprotection of atmospheric air of inhabited places (from pollution by chemical and biological substances) Order of the Ministry of Health of Ukraine No. 201 dated 07.09.1997	https://regulation.gov.ua/documents/id238138

Table 6 - List of legislation related to soil

Country acronym	National, EU or international legislation related to soil		Link
	Title (national language)	Title (in English)	
AT	„Österreichische Orientierungswerte für Schadstoffgehalte im Oberboden (0-20cm) für landwirtschaftliche oder gärtnerische Nutzung (ÖNORM L 1075)“	"Austrian orientation values for pollutant contents in the topsoil (0-20cm) for agricultural or horticultural use (ÖNORM L 1075)"	–
BA	(“Službene novine Federacije BiH” broj 72/09) “Pravilnik o utvrđivanju dozvoljenih količina štetnih i opasnih materija u zemljištu i metode njihovog ispitivanja”	(“Official Newspapers of Federation of B&H” No 72/09) “Regulations on establishing the validity of the quantity of damaged and dangerous materials in the land and the methods of their examination“	http://www.fuzip.gov.ba/bundles/websitenews/gallery/files/116/1496150694100_Pravilnik_o_utvrđivanju dozvoljenih količina štetnih i opasnih materija u zemljištu I metode njihovog ispitivanja
	“Službene novine Federacije BiH” broj 52/09) “Zakon o poljoprivrednom zemljištu”	(“Official Newspapers of Federation of B&H” No 52/09) “Law on Agricultural Land”	https://advokat-prnjavorac.com/zakoni/Zakon-o-poljoprivrednom-zemljistu-FBiH.pdf
	(“Službene novine Federacije Bosne i Hercegovine” broj 33/03, 38/09) “Zakon o zaštiti okoliša”	(“Official Newspapers of Federation of B&H” No 33/03, 38/09) „Law on Environmental Protection“	http://extwprlegs1.fao.org/docs/pdf/bih130990.pdf
BA-SRP	Zakon o zaštiti životne sredine (Službeni glasnik	Law on environment (Official Gazette of Republic of Srpska 71/12, 79/15)	http://www.narodnaskupstinars.net/?q=la/akti/usvojeni-zakoni/zakon-o-za%C5%A1titi-%C5%BEivotne-sredine

Country acronym	National, EU or international legislation related to soil		Link
	Title (national language)	Title (in English)	
	Republike Srpske broj 71/12, 79/15)		
BG	Закон за почвите	Soil Law	https://www.moew.government.bg/bg/pochvi/zakonodatelstvo/nacionalno-zakonodatelstvo/
	НАРЕДБА № 3 от 1 август 2008 г. за нормите за допустимо съдържание на вредни вещества в почвите (обн. ДВ. бр.71 от 12 Август 2008 г.)	Regulation for the levels of maximum allowable concentration of harmful substances in soils	https://www.moew.government.bg/bg/pochvi/zakonodatelstvo/nacionalno-zakonodatelstvo/
	НАРЕДБА № 4 от 12 януари 2009 г. за мониторинг на почвите (обн. ДВ. бр.19 от 13 Март 2009 г.)	Regulation for soil monitoring	https://www.moew.government.bg/bg/pochvi/zakonodatelstvo/nacionalno-zakonodatelstvo/
	Тематична стратегия за почвите ЕС	Thematic Strategy for Soil Protection EU	https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0231:FIN:EN:PDF
	-	Guide Municipal Soil Management EU	https://www.moew.government.bg/static/media/ups/tiny/filebase/Soil/Programi/08_Guide_for_municipal_soil_management.pdf
HR	Pravilnik o zaštiti poljoprivrednog zemljišta od onečišćenja	Ordinance on the protection of agricultural land from pollution	https://narodne-novine.nn.hr/clanci/sluzbeni/2014_01_9_167.html
DE	-	-	-
HU	6/2009. (IV. 14.) KvVM-EüM-FVM együttes rendelet a földtani közeg és a felszín alatti víz szennyezéssel szembeni védelméhez	6/2009. (IV. 14.) KvVM-EüM-FVM Joint Decree on Limits and Measurement of Pollutants for the Protection of Soil and Groundwater from Pollution	https://net.jogtar.hu/jogszabaly?docid=a0900006.kvv

Country acronym	National, EU or international legislation related to soil		Link
	Title (national language)	Title (in English)	
	szükséges határértékekről és a szennyezések méréséről		
MD	MINISTERUL ECOLOGIEI ŞI RESURSELOR NATURALE. INSTRUCŢIUNE Nr. 383 din 08.08.2004, privind evaluarea prejudiciului cauzat resurselor de sol	Ministry of Environment and Natural Resources, Instruction nr. 383 from 08.08.2004 for the Evaluation of the demage caused to soil resorces	http://lex.justice.md/index.php?action=view&view=doc&id=310719
ME	Zakonom o poljoprivrednom zemljištu ("Sl list RCG", br. 015/92, 059/92, 027/94, "Sl list CG", br. 073/10, 032/11)	The Law on Agricultural Land ("Official Gazette of RME", No. 015/92, 059/92, 027/94, ("Official Gazette of ME", No. 073/10, 032/11)	http://podgorica.me/db_files/Urbanizam/Zakoni/zakon_o_poljoprivrednom_zemljistu.pdf
	Pravilnikom o dozvoljenim koncentracijama štetnih i opasnih materija u zemljištu i metodama za njihovo ispitivanje („Sl. list RCG", br. 18/97).	Regulations on allowed concentrations of harmful and hazardous substances in soil and methods for their examination ("Official Gazette of RME", no. 18/97).	-
RO	ORDIN nr.184/1997 pentru aprobarea Procedurii de realizare a bilanturilor de mediu	ORDER no.184 / 1997 for approval of the Environment Balance Sheet Procedure	http://www.mmediu.ro/app/webroot/uploads/files/OM-184-1997-bilant-de-mediu-si-OM-756-1997-evaluarea-poluarii-mediului.pdf
	ORDIN nr.756/1997	ORDER no. 756/1997	https://biosol.ro/wp-content/uploads/linkuri/ord-756-din-03-11-1997-pentru-aprobarea-Reglementarii-privind-evaluarea-poluarii-mediului.pdf

Country acronym	National, EU or international legislation related to soil		Link
	Title (national language)	Title (in English)	
RS	Uredba o graničnim vrednostima zagađujućih, štetnih i opasnih materija u zemljištu	Regulation on limit values of polluting, harmful and dangerous substances in soil	http://www.pravno-informacioni-sistem.rs/SlGlasnikPortal/eli/rep/sgrs/vlada/uredba/2018/30/2/reg
	Uredba o programu sistemskog praćenja kvaliteta zemljišta, indikatorima za ocenu rizika od degradacije zemljišta i metodologiji za izradu remedijacionih programa	Regulations on systematic monitoring of soil quality, indicators for land degradation risk assessment and methodology for the development of remediation programs	http://www.pravno-informacioni-sistem.rs/SlGlasnikPortal/eli/rep/sgrs/vlada/uredba/2010/88/2/reg
SK	Rozhodnutie MP SR č. 531/1994 o najvyšších prípustných hodnotách škodlivých látok v pôde	Decision no. 531/1994 on maximum levels of harmful substances in soil	-
	Zákon č. 188/2003 Z.z. z 23. apríla 2003 o aplikácii čistiarenského kalu a dnových sedimentov do pôdy	Act no. 188/2003 Coll. on the application of sludge and bottom sediments to soil	www.slov-lex.sk
SI	Uredba o mejnih, opozorilnih in kritičnih imisijskih vrednostih nevarnih snovi v tleh (Uradni list RS, št. 68/96 in 41/04 – ZVO-1)	Regulation the limit, warning and critical levels of hazardous substances in soil	http://pisrs.si/Pis.web/pregledPredpisa?id=URED114

Country acronym	National, EU or international legislation related to soil		Link
	Title (national language)	Title (in English)	
UA	Гранично допустимі концентрації хімічних речовин у ґрунті (ГДК) 30.10.1980 N 2264-80	Maximum permissible concentrations of chemical substances in soil (MPC) 30.10.1980 N 2264-80	https://zakon.rada.gov.ua/laws/show/v2264400-80#o3
	Санитарные нормы	Sanitary standards	http://gostrf.com/normadata/1/4293852/4293852447.pdf
	ДОПУСТИМЫХ КОНЦЕНТРАЦИЙ ХИМИЧЕСКИХ ВЕЩЕСТВ В ПОЧВЕ	ACCEPTED CONCENTRATIONS OF CHEMICAL SUBSTANCES IN SOIL	-
	СанПиН 42-128-4433-87		-
	СанПиН 4266-87 Методические указания по оценке степени опасности загрязнения почвы химическими веществами.	SanPin 4266-87	http://www.gostrf.com/normadata/1/4293852/4293852444.pdf
	13.03.1987 Главный государственный санитарный врач СССР	Guidelines for assessing the degree of hazard of soil contamination by chemicals. 13.03.1987 USSR Chief Public Health Officer	-

Table 7 – List of legislation related to sediments

Country acronym	National, EU or international legislation related to sediments		Link
	Title (national language)	Title(in English)	
AT	-		
BA	-		
BA-SRP			
BG	-		

Country acronym	National, EU or international legislation related to sediments		Link
	Title (national language)	Title(in English)	
HR			
DE			
HU			
MD			
ME			
RO	Ord.161/2006	Order no. 161 of 16/02/2006 for the approval of the Normative on the Classification of Surface Water Quality to establish the ecological status of the water bodies (includes quality of sediments)	http://legislatie.just.ro/Public/DetaliiDocument/72574
SK	Smernica MŽP SR č. 4/1999-3 na zostavovanie a vydávanie Geochemickej mapy riečnych sedimentov v mierke 1:50 000	Directive of the Ministry of Environment of the Slovak Republic no. 4 / 1999-3 for the compilation and issue of a geochemical map of river sediments at a scale of 1:50 000	http://www.minzp.sk/oblasti/geologia/pravne-predpisy/
	Metodický pokyn MŽP SR č. 549/98-2 na hodnotenie rizík zo znečistených sedimentov tokov a vodných nádrží	Methodological Instruction of the Ministry of Environment of the Slovak Republic no. 549 / 98-2 for the risk assessment from contaminated sediments of streams and water reservoirs	
	Vyhláška MZe ČR s MŽP ČR č. 257/2009 Sb. o používání sedimentů na zemědělské půde	Decree of the Ministry of Agriculture with the Ministry of the Environment of the Czech Republic no. 257/2009 Coll. on the use of sediments on agricultural land	https://www.zakonyprolidi.cz/cs/2009-257

Country acronym	National, EU or international legislation related to sediments		Link
	Title (national language)	Title(in English)	
	Zákon č. 188/2003 Z.z. z 23. apríla 2003 o aplikácii čistiarenského kalu a dnových sedimentov do pôdy	Act no. 188/2003 Coll. on the application of sludge and bottom sediments to soil	www.slov-lex.sk
		EPA "Consensus-Based Sediment Quality Guidelines"	
		Canadian Standard „Provincial Sediment Quality Guidelines (PSQG)	
		Canadian Standard „Canadian Sediment Quality Guideline for the Protection of Aquatic Life (CSQG)"	
SI			
SR			There are provided details referring to the content of HSs in sediments, but the law title was not listed
UA			

Conclusions

National legislation includes concern for monitoring the environmental quality of groundwater, surface water, air, soils and sediments, for drinking water, waste water (used in industry or by population). Also, European water legislation is implemented in all these countries, annually monitoring the water bodies, in line with EU-WDF (Water Framework Directive).

As concerns the monitoring of toxic substances content, there is an impressive number of national or European laws that act to reduce or even prohibit polluting technologies, reduce the discharge of wastewater (from industry) in the Danube and improve the purification technologies of sewage or waste water. In this respect, the maximum and normal limits of hazardous substances in air, water, sediment, biota may be lower in the future, the chronic pollution being remedied over the years, depending on the results of their remedial measures. The activity in this field is carried out in all partner countries, by applying the information provided by international guides and a rich experience gained over years in this field.

Noteworthy is the fact that the international guidelines can be applied with restrictions, because the geological particularities, biota specificity, demographic peculiarities, pollution sources and pollutant categories for waters in partner countries could not be found in the general common legislation.

Regarding the legal norms on sediment pollution, monitoring and establishing quality classes, there is national legislation only in the Republic of Slovakia and Serbia. Some countries (Romania, Slovenia) have some previsions related to sediments in the laws regarding water. For example, in Romania, within the legislation on water quality, there are also mentioned the admissible levels of harmful substances in sediments.

In conclusion, the elaboration of SIMONA guide, based on the data in the Danube River Basin, and on the informations in the general guides, is necessary.

I.2. List of hazardous substances in waters, soils, sediments and biota

This chapter refers to the lists of dangerous (hazardous) substances (metals, non-metals, PAHs, PCBs, other parameters) concentration levels, their significance (definition of terms used for thresholds) in waters, solids or biota, in accordance with the national legislative framework.

Table 8 below contains the meaning of the terms "normal values" and "maximum values" in surface, groundwater and drinking waters in the following tables extracted from the legislation of each partner country. It is also useful to observe the peculiarities of national legislation and to take "good practices" in developing the SIMONA guide.

Table 8 – Definitions of maximum, minimum/normal content in water

Country acronym	Means of "maximum content" in water	Means of "minimum or normal content" in water
AT	For river water: Acceptable supplement-concentration according to OZV Chemistry-OG For drinking water :Acceptable concentration-for groundwater according to QZV-Chemistry-OG For drinking water only a set of admissible values	For river water: Background-concentration according to QZV-Chemistry-OG For groundwater: less sensitive values
BA	*The maximum permissible concentrations of certain hazardous substances in surface waters are levels for classes 3 and4* -a single list of levels in drinking waters -no information for groundwater bodies	*The normal concentrations of certain hazardous substances in surface waters are levels for classes 1and 2*

Country acronym	Means of "maximum content" in water	Means of "minimum or normal content" in water
BA-SRP	A single set of threshold values for drinking water and surface water	
BG	For river water there are two classes (inland surface water and other surface waters).For each class there is a list for maximum allowable concentration. Inland waters have 5 classes. Cd is listed for each class. For Cu and Zn (depending on $CaCO_3$ concentration - 5 classes) For drinking water only one list of values.	Normal values of concentration of inland surface water
HR	For drinking water - a single set named threshold value For groundwater - a single set named threshold value For river water there are two classes (inland surface water and other surface waters). For each class there is a list for maximum allowable concentrations. Threshold of Cd concentration depending on $CaCO_3$ concentration (5 classes).	No set of normal values
DE	-	-
HU	Environmental Quality Standards (EQSs) for the waters according to EU-WFD (AA-EQS for annual average concentrations and MAC-EQS for maximum acceptable concentrations). HU has three status classes for metals: 1) bellow natural background, 2) good status, 3) failed; and two classes for other priority substances: 1) good status, 2) bad status.	
MD		

Country acronym	Means of “maximum content” in water	Means of “minimum or normal content” in water
ME	Sets out the classification and categorization of surface and groundwater on land and sea water in Montenegro according to “Regulation on Classification and Categorization of surface water and Groundwater in Montenegro (Official Gazette of Montenegro 27/07)” According to the purpose, water is classified into water that can be used for: - drinks and food industry (divided into four classes namely: 1) Class A - Water that can be used for drinking in natural conditions with possible disinfection; 2) Class A1 - Water that can be used for drinking after a simple physical process of processing and disinfection; 3) Class A2 - Water that can be used for drinking after proper conditioning (coagulation, filtration and disinfection); 4) Class A3 - Water that can be used after a treatment requiring intensive physical, chemical and biological treatment with extended disinfection and chlorination, i.e. coagulation, flocculation, decantation, filtration, active carbon absorption and ozone or chlorine disinfection. - fishing and shellfish farming. 1) Class S - Water that can be used for the production of precious fish species (salmonids); 2) Class S - Water that can be used for shellfish farming; 3) Class C - Water that can be used for the cultivation of less precious species of fish (cyprinids)	”minimum or normal content “means class A

Country acronym	Means of “maximum content” in water	Means of “minimum or normal content” in water
	- bathing (other than pool water and water used for therapeutic purposes) 1) *Class K1 - Excellent* *2) Class K2 - Satisfactory* Water bodies of surface and groundwater are classified into categories that meet the following conditions: 1) Category I - fresh water of classes A1, S and K1 and salty waters and classes Š; 2) Category II - Class A2, C and K2; 3) Category III - Class A3 ”maximum content” in water means ClassA3	

Country acronym	Means of "maximum content" in water	Means of "minimum or normal content" in water
RO	A single set of threshold values for river and drinking water. 5 ecological classes are set for rivers and natural lakes: (I) very good; (II) good; (III) moderate; (IV) weak and (V) bad. Thease are established based on biological, hydromorphological, chemical and physico-chemical quality elements, foreseen in the law. For the lakes the trophic level will be also taken into account. To the 5 ecological classes correspond 5 trophic levels: ultraoligotroph, oligotroph, mesotroph, eutroph and hypertroph.	
SK	Environmental Quality Standards (EQSs) for the surface waters according to EU-WFD.	
SR	"Maximum content" in water means Class 5 Class V- poor ecological status according to the classification given in the regulation that prescribes the parameters of ecological and chemical status for surface waters. Surface waters belonging to this class cannot be used for any purpose. The classification of surface water quality in Serbia contains 5 categories: Class II- good ecological status according to the classification given in the regulations prescribing ecological and chemical status parameters for surface waters. Surface waters belonging to this class are provided on the basis of the limit values of quality elements for the functioning of ecosystems, life and protection of fish (cyprinids) and can be used for the same purposes and under the same conditions as surface waters belonging to class I. Class III- moderate ecological status according to the classification given in the regulation that prescribes environmental and chemical status parameters for surface waters. Surface waters belonging to this class are provided on the basis of limit values of quality	"Normal content" in water means class1 Class I- excellent ecological status according to the classification given in the regulation that prescribes ecological and chemical status parameters for surface waters. Surface waters belonging to this class aree provided on the basis of the limit values of quality elements for the functioning of ecosystems, life and protection of fish (salmonids and cyprinids) and can be used for the following purposes: supply of drinking water with prior treatment by filtration and disinfection, bathing and recreation, irrigation, industrial use.

Country acronym	Means of “maximum content” in water	Means of “minimum or normal content” in water
	elements for life and protection of cyprinids and can be used for the following purposes: drinking water supply with prior treatment by coagulation, flocculation, filtration and disinfection, bathing and recreation, irrigation, industrial use. Class IV- weak ecological status according to the classification given in the regulations that prescribe the ecological and chemical status parameters for surface waters. Surface waters belonging to this class based on the limit values of quality elements can be used for the following purposes: drinking water supply using combination of previously mentioned treatments and advanced methods of treatment, irrigation, industrial use.	
SI	Drinking water – one set of values. “Maximum content”= the maximum allowed concentration. In the river water, for Cd and Zn there are 4 sets of values, depending on water hardness.	There is a set of “normal” values.
UA	“Maximum” = intervention thresholds. For drinking water there are 5 sets of values	There is a set of “normal” values

In the following tables referring to water, the term “major elements” was used by extension from geological samples (rocks, minerals) but it is not rigorously defined. This term was also used by extension to soils.

Table 9 – Maximum content of trace elements in river water

Country acronym		Trace elements [µg/l] - Maximum content - River water																			
		Ag	As	B	Be	Cd	Cr	Co	Cu	Hg	Mo	Ni	Pb	Sb	Se	Sn	Tl	V	Zn	U	Te
AT		0.1	24	-	-	1.5	8.85	-	8.8	0.07	-	34	14	-	5.3	-	-	-	52	-	-
BA		-	50	-	-	5	20	-	20	1	500	-	80	-	10	-	30	200	200	-	-
BA-SRP		-	-	-	-	-	-	-	-	0.05	-	20	7.2	-	-	-	-	-	-	-	-
BG		-	25	-	-	1.5	32	-	-	0.07	-	34	14	-	-	-	-	-	-	-	40
HR		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HU		-	-	-	-	1.5	32	-	-	0.07	-	34	14	-	-	-	-	-	-	-	-
MD		-	-	-	-	5	-	-	-	2	-	100	50	-	-	-	-	-	400	-	-
ME		-	50	1000	50	5	-	50	100	1	-	100	50	-	10	-	-	100	5000	50	-
RO		-	10	-	-	0.5	25	-	20	0.1	-	10	5	-	-	-	-	-	100	-	-
RS	surface water	-	100	2500	-	-	250	-	1000	-	-	-	-	-	-	-	-	-	5000	-	-
	groundwater	40	60	625	15	6	30	100	75	0.3	300	5	75	20	160	50	7	70	800	-	70
SK	surface water	5	7.5	-	-	1.5	9	50	8.8	0.07	-	20	7.2	-	20	-	-	20	52	50	-
	groundwater in quaternary	-	7.5	-	-	2	27	-	505	0.7	-	-	10	-	6	-	-	-	-	-	-
	groundwater in pre-quaternary rocks	-	10	-	-	2.5	26	-	503	0.7	-	-	9	-	6	-	-	-	-	-	-
SI		-	21	-	-	1.5	2.8	-	73	0.07	-	34	14	-	-	-	-	-	520	-	-
UA		-	0.05	4		0.005	0.05	0.05	0.1	0.002	0.2	0.1	0.1	-	-	-	-	-	1		

Table 10 – Maximum content of major elements in river water

Country acronym		Major elements[µg/l]- Maximum content - River water							
		Al	Ba	Fe	Mg	Mn	Na	K	Ca
AT		-	-	-	-	-	-	-	-
BA		-	-	-	-	-	-	-	-
BA-SRP		-	-	-	-	-	-	-	-
BG		25	-	100	-	-	-	-	-
HR		-	-	-	-	-	-	-	-
DE		-	-	-	-	-	-	-	-
HU		-	-	-	-	-	-	-	-
MD		-	-	100	100000	2000	-	-	-
ME		-	1000	-	-	50	-	-	-
RO		-	-	2000	-	1000	-	-	-
RS	surface water	-	-	2000	1000	-	-	-	-
	groundwater	-	625	-	-	-	-	-	-
SK	surface water	200	-	-	200000	300	100000	-	100000
	groundwater in quaternary sediments	-	-	200	-	50	119000	-	-
	groundwater in pre-quaternary rocks	-	-	950	-	200	79000	-	-
SI		-	-	-	-	-	-	-	-
UA		-	-	-	-	-	-	-	-

Table 11 – Normal content of trace elements in river water

Country acronym		Trace elements [µg/l] - Normal content - River water																	
		Ag	As	B	Be	Cd	Cr	Co	Cu	Hg	Mo	Ni	Pb	Sb	Se	Sn	Tl	V	Zn
AT		-	0	-	-	0.01	0.05	-	0.05	-	-	4	1.2	-	-	-	-	-	1
BA		-	50	-	-	0.5	1	-	2	0.02	500	-	2	-	10	-	3	100	50
BA-SRP		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BG		-	10	-	-	0.08	0.6	-	1	-	-	4	1.2	-	-	-	-	-	-
HK		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HU	EQSadded[1]	-	0,5	-	-			-	-	-	-	-	-	-	-	-	-	-	10.9*
	EQStotal[2]	-	8.2	-	-	0.08-0.25	4.7	-	1*	-	-	4*	1.2*	-	-	-	-	-	-
MD		-	1	500		-	-	1	5	1	-	2	1	-	-	-	-	-	10
ME		-	1	500	1	-	-	1	5	1	-	2	0	-	1	-	-	1	10
RO		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RS		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SK	surface water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	groundwater in quaternary sediments	-	5.25	-	-	1.6	25	-	500	0.5	-	-	5.5	5	-	-	-	-	-
	groundwater in pre-quaternary rocks	-	5	-	-	1	26	-	503	0.5	-	-	5	-	6	-	-	-	-
SI		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UA		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

[1] EQSadded: EQS based on added risk approach. The EQS should be increased with the local ABC (ambient background concentration)

[2] EQStotal: EQS based on total risk approach. See CIS EQS-TGD.

* bioavailable concentration

Table 12 – Normal content of major elements in river water

Country acronym		Major elements[µg/l]- Normal content - River water						
		Al	Ba	Fe	Mg	Mn	Na	K
AT		-	-	-	-	-	-	-
BA		-	-	-	-	-	-	-
BA-SRP		-	-	-	-	-	-	-
BG		10-15	-	50	-	50	-	-
HR		-	-	-	-	-	-	-
DE		-	-	-	-	-	-	-
HU		-	-	-	-	-	-	-
MD		-	-	20	50	100	-	-
ME		-	100	-	-	5	-	-
RO		-	-	200	-	50	-	-
RS		-	-	-	-	-	-	-
SK	Quaternary rocks	-	-	105	-	26	50000	-
	Quaternary sediments	-	-	125	-	26	103000	-
SI		-	-	-	-	-	-	-
UA								

A number of other substances (chlorine, fluorine, phosphorus, ammonium, nitrite, SO_4 etc.) that are relevant in determining the quality of river, underground or drinking water need to be analyzed. The maximum permissible values for these substances are listed in all questionnaires (Annexes 2-15) and can be compared when they are set in the SIMONA guide.For example, the threshold values for groundwater (Croatia) are prestened in Table .13.

Table 13 – Threshold values for groundwater in Croatia

Indicator	Threshold limit value
arsenic (As)* [µg/l]	10
cadmium (Cd) [µg/l]	5
lead (Pb)* [µg/l]	10
mercury (Hg) [µg/l]	1
ammonium (NH_4)* [mg/l]	0,5
chlorides (Cl) [mg/l]	250
sulphates (SO_4) [mg/l]	250
orthophosphates (PO_4) [mg/l]	0,2
nitrites (NO_2) [mg/l]	0,5
total phosphorus (P)*/** [mg/l]	0,35

These substances are very important as some of them are eutrophication indicators (for example, yearly average threshold values of eutrophication indicators in rivers in Croatia legislation – Table 14).

Table 14 – Yearly average threshold values of eutrophication indicators in Croatia

Indicator	very good	good
Nitrates [mgN/l]	0,4 – 1,0	0,7 – 2,5
Total phosporus [mgP/l]	0,02 – 0,15	0,06 – 0,35
Chlorophyll a [µg/l]	5,9 – 20,0	10,0 – 40,0

Table 15 – Maximum content of trace elements in drinking water

Country acronym		Trace elements [µg/l] - Maximum content - Drinking water																	
		Ag	As	B	Be	Cd	Cr	Co	Cu	Hg	Mo	Ni	Pb	Sb	Se	Sn	Tl	V	Zn	U
AT		-	10	1000	-	5	50	-	2000	1	-	20	10	-	-	-	-	-	-	15
BA		-	10	-	-	5	50	-	2000	1	-	20	10	5	-	-	-	-	-	-
BA-SRP		-	10	1000	-	5	50	-	2000	1	-	-	-	5	10	-	-	-	3000	-
BG		-	10	-	-	5	50	-	2000	0.1	-	20	10	-	10	-	-	-	-	-
HR		10	10	1000	-	5	50	-	2000	1	-	20	10	5	10	-	-	5	3000	-
DE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HU		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MD		-	10	500	-	3	50	-	1000	1	-	20	10	5	10	-	-	-	3000	-
ME		-	10	1000	-	5	50	50	2000	1	-	20	10	-	-	-	-	-	3	-
RO		-	10	-	-	5	50	-	100	1	-	20	10	-	-	-	-	-	5000	-
RS	drinking water	-	10	300	-	3	50	-	2000	1	70	20	10	3	10	-	-	100	3000	-
	bottled water	10	50	1000	0.2	5	50	-	100	1	-	10	50	10	10	-	-	1	100	50
SK		50	10	1000	-	5	50	-	2000	1	-	20	10	5	10	-	-	-	-	-
SI		-	10	1000	-	5	50	-	2	1	-	20	10	-	10	-	-	-	-	-
UA		-	0.05	1	-	0.004	0.05	0.1	0.003	0.002	0.5	0.1	0.1	-	-	-	-	-	1	-

Table 16 – Maximum content of major elements in drinking water

Country acronym		Major elements[µg/l]- Maximum content - Drinking water							
		Al	Ba	Fe	Mg	Mn	Na	K	Ca
AT		-	-	-	-	-	-	-	-
BA		0.2	-	200	-	50	200000	-	-
BA-SRP		200	-	200	50000	50	200000	-	200000
BG		-	-	-	-	-	-	-	-
HR		200	700	200	-	50	200000	12000	
DE		-	-	-	-	-	-	-	-
HU		-	-	-	-	-	-	-	-
MD		200	-	300	-	50	-	-	-
ME		-	-	200	-	-	-	-	-
RO		-	-	-	-	-	-	-	-
RS	drinking water	-	700	-	50000	-	70	12000	20000
	bottled groundwater	50	100	50	30000	20	20000	10000	10000
SK		200	-	200	-	50	200000	-	>30000*
SI		200	-	200	-	50	20000	-	-
UA		-	-	-	-	-	-	-	-

* Recomended minimal value, no limit for maximum concentration

Table 17 – Normal content of trace elements in drinking water

Country acronym	Trace elements [µg/l] - Normal content - Drinking water																	
	Ag	As	B	Be	Cd	Cr	Co	Cu	Hg	Mo	Ni	Pb	Sb	Se	Sn	Tl	V	Zn
AT	-	7.5	750	-	3.75	3.75	-	1500	0.75	-	15	7.5	-	-	-	-	-	-
BA	-	10	-	-	5	50	-	2000	1	-	20	10	5	-	-	-	-	-
BA-SRP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ME	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 18 - Normal content of major elements in drinking water

Country acronym	Major elements[µg/l]- Normal content - Drinking water						
	Al	Ba	Fe	Mg	Mn	Na	K
AT	-	-	-	-	-	-	-
BA	200	-	200	-	50	0.2	
BA-SRP	-	-	-	-	-	-	-
BG	-	-	-	-	-	-	-
HR	-	-	-	-	-	-	-
DE	-	-	-	-	-	-	-
HU	-	-	-	-	-	-	-
MD	-	-	-	-	-	-	-
ME	-	-	-	-	-	-	-
RO	-	-	-	-	-	-	-
RS	-	-	-	-	-	-	-
SK	-	-	-	-	-	-	-
SI	-	-	-	-	-	-	-
UA	-	-	-	-	-	-	-

In all questionnaires there are indicated the radiological parameters for waters. For example, in surface waters, in Slovakia (Annex 13), the analyzed indicators are shown in Table 19.

Table 19 – Radioactivity indicators in surface waters in Slovakia

Indicator	Symbol	Unit	Value
Total bulk activity alpha	$a_{V,c\alpha}$	$Bq.l^{-1}$	0.5
Total bulk activity beta	$a_{V,c\beta}$	$Bq.l^{-1}$	1
Radium 226	^{226}Ra	$Bq.l^{-1}$	0.2
Uranium natural	U_{nat}	$\mu g.l^{-1}$	50
Tritium	^{3}H	$Bq.l^{-1}$	100
Strontium	^{90}Sr	$Bq.l^{-1}$	1.0
Cesium	^{137}Cs	$Bq.l^{-1}$	0.5

The maximum allowable amount of toxic or carcinogenic or radioactive substances in soils has been selected according to the legislation of each country, as will be explained in the following table. In some countries there are two sets of values: one for background levels generated by the geological environment, and one for polluted soils that do not affect the health, or do not disturb the activity (use) that takes place on those lands.

Table 20 - Definitions of maximum, minimum/normal content in soils

Country acronym	Means of "maximum content" in soils	Means of "minimum or normal content" in soils
AT	Values relevant for contaminated sites	orientation values for agricultural soils According to: „Österreichische Orientierungswerte für Schadstoffgehalte im Oberboden (0-20cm) für landwirtschaftliche oder gärtnerische Nutzung (ÖNORM L 1075)“
BA	The list of limit values in clay soil (depending on the texture of the soil there are three classes: sandy soil, clayey silt soil, clay soil)	*The normal concentrations of certain hazardous substances are the values in sandy soil*
BA-SRP		
BG	5 sets-Standard soils normal values, 2 sets for maximum allowable concentration (agricultural lands and grasslands) and one alert threshold "maximum content"= alert threshold	The list for Standard soil pH ($H_2O \leq 6$) normal values
HR	The list of limit values in clay soil(depending on the texture of the soil there are three classes: sandy soil, clayey silt soil, and clayey soil). The maximum content are listed for clayey soil	The normal content are list for sandy soil
DE		
HU	(Ci) action contamination limit: the concentration of risk material specified in legislation or, in the absence thereof, in an official decision, in the case of which, in the absence of a specific pollution limit value (E) or (D) no remediation contamination limit, the environmental inspectorate shall take action.	(A) background concentration: representative value, the natural or near-concentration concentration of each substance (s) in the groundwater, or in the soil. (Ao) proven background concentration: a concentration specific to a given area instead of background concentration (A), which is the

	(D) remediation contamination limit: the concentration specified in the official decision, to be achieved as a result of remediation, taking into account land use, to prevent damage to human health and ecosystems. Its definition is based on complex risk assessment on the distribution, behavior, spread or model calculations of risky material between environmental elements, and on quantitative risk assessment. (E) specific contamination limit: on site, instead of (B) contamination limit, on the basis of Annex IV. in the case of an activity that has already been carried out at the time of entry into force or in areas where the proven background concentration (Ab) exceeds the contamination limit (B) - based on the actual knowledge of the situation, based on a quantitative risk assessment, taking into account land use taking into account the contamination limit set in the official decision. The specific contamination limit (E) shall not be more stringent than the contamination limit (B) and shall not be less than the actual pollutant concentration established by the test or the (D) remediation contamination limit.	result of exposure to natural conditions and other environmental elements outside the groundwater geological medium. (B) Pollution Limit: a risky substance concentration determined by law or, in the absence thereof, by an official decision - taking into account groundwater for the quality of drinking water and the requirements of the aquatic ecosystem, the multifunctionality of the soils and the sensitivity of the groundwater to pollution.
MD		
ME	The maximum level of hazardous harmful substances in soils means maximum permissible concentrations	
RO		
RS	The maximum level = Remediation value.	Normal value = Target value

	The classification of soil quality in Serbia contains the categories: Target value, Maximum allowed value and Remediation value)	
SK	C (intervention value) according to Decision No. 531/94-540 A – reference value, B – indication value (if value exceeded, site monitoring is required), C – intervention value (if value exceeded, remediation measures are required)	A – reference value
SI	The maximum level = Critical Values (hereinafter referred to as critical value) is the density of specific hazardous substances in the soil, where due to adverse effects or impacts on humans and the environment contaminated soil is not suitable for the cultivation of crops intended for human or animal consumption and for retaining or filtering water. Obs.: Three class values: The limit value, Critical Values, Signal Levels (hereinafter: the warning value) is the density of specific hazardous substances in the soil, which means on certain types of land use, the likelihood of adverse effects or impacts on human health or the environment.	Normal value= The limit value (hereinafter threshold) is the density of specific hazardous substances in the soil, which constitutes a load floor to provide living conditions for plants and animals, and which does not impair the quality of groundwater and soil fertility. At this value, the effects or impacts on human health or the environment are acceptable.
UA		

Table 21 – Maximum content of trace elements in soils

Country acronym	Trace elements[µg/g] - Maximum content of metals in soils																		
	Ag	As	B	Be	Cd	Cr	Co	Cu	Hg	Mo	Ni	Pb	Sb	Se	Sn	Tl	V	Zn	Te
AT	-	200	-	-	10	500	-	500	-	-	500	500	-	-	-	-	-	1500	-
BA	-	20	-	-	1.5	100	-	80	1.5	-	50	100	-	-	-	-	-	200	-
BA-SRP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BG	-	90	-	-	12	550	-	500	10	-	300	500	-	-	-	-	-	900	-
HR	-	-	-	-	2	120	-	120	1.5	-	75	150	-	-	-	-	-	200	-
DE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MD	-	-	-	-	2	90	15	140	2.1	-	75	32	4.5	-	4.5	-	150	300	-
ME	-	20	5	-	2	20	50	100	1.5	10	50	50	-	-	-	-	-	300	-
RO	40	50	10	15	10	600	250	500	10	40	500	1000	1500	20	300	5	400	1500	-
RS	15	55	-	30	12	380	240	190	10	200	210	530	15	100	900	15	250	720	600
SK	-	50	-	30	20	800	300	500	10	200	500	600	-	20	30	-	500	3000	-
SI	-	50	-	-	12	380	-	300	10	-	210	530	-	-	-	-	-	720	-
UA	-	10	-	-	4	100	-	32	2.1	-	100	32	-	-	-	-	150	110	-

Table 22 - Maximum content of major elements in soils

Country acronym	Major elements[µg/g] - Maximum content in soils						
	Al	Ba	Fe	Mg	Mn	Na	K
AT	-	-	-	-	-	-	-
BA	-	-	-	-	-	-	-
BA-SRP	-	-	-	-	-	-	-
BG	-	-	-	-	-	-	-
HR	-	-	-	-	-	-	-
DE	-	-	-	-	-	-	-
HU	-	-	-	-	-	-	-
MD	-	-	-	-	1500	-	-
ME	-	-	-	-	-	-	-
RO	-	2000	-	-	4000	-	-
RS	-	625	-	-	-	-	-
SK	-	2000	-	-	-	-	-
SI	-	-	-	-	-	-	-
UA	-	-	-	-	1500	-	-

Table 23 - Normal content of major elements in soils

Country acronym	Major elements [µg/g]- Normal content - Soils						
	Al	Ba	Fe	Mg	Mn	Na	K
AT	-	-	-	-	-	-	-
BA	-	-	-	-	-	-	-
BA-SRP	-	-	-	-	-	-	-
BG	-	-	-	-	-	-	-
HR	-	-	-	-	-	-	-
DE	-	-	-	-	-	-	-
HU	-	-	-	-	-	-	-
MD	-	-	-	-	-	-	-
ME	-	-	-	-	-	-	-
RO	-	200	-	-	200	-	-
RS	-	160	-	-	-	-	-
SK	-	500	-	-	-	-	-
SI	-	-	-	-	-	-	-
UA	-	-	-	-	-	-	-

Table 24 - Normal content of trace elements in soils

Country acronym	Trace elements[µg/g]- Normal content - Soils																	
	Ag	As	B	Be	Cd	Cr	Co	Cu	Hg	Mo	Ni	Pb	Sb	Se	Sn	Tl	V	Zn
AT	-	20	-	-	1	100	50	100	1	-	60	100	-	-	-	-	-	300
BA	-	10	-	-	0.5	50	-	50	0.5	-	30	50	-	-	-	-	-	100
BA-SRP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BG	-	10	-	-	0.4	65	20	34	0.03	-	46	26	-	-	-	-	-	88
HR	-	-	-	-	0	0	0	0	0	0	0	0	-	-	-	-	-	0
DE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HU		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MD		2	-	-	0.2	-	12	18	0.1	-	35	16	-	-	-	-	-	60
ME		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RO	2	5	1	1	1	30	15	20	0.1	2	20	20	5	1	20	0.1	50	100
RS	-	29	-	1.1	0.8	100	9	36	0.3	3	35	85	3	0.7	-	1	42	140
SK	-	29	-	3	0.8	130	20	36	0.3	40	100	150	-	0.8	20	-	120	140
SI	-	20	-	-	1	100	-	60	0.8	50	85	-	-	-	-	-	-	200
UA																		

Table 25 - Maximum content of trace elements in river sediments

Country acronym	Trace elements[µg/g]- Maximum content - River sediments																	
	Ag	As	B	Be	Cd	Cr	Co	Cu	Hg	Mo	Ni	Pb	Sb	Se	Sn	Tl	V	Zn
AT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BA-SRP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HR	-	55	-	-	12	380	-	190	10	200	210	530	-	-	-	-	-	720
DE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MD	-	2	-	-	3	-	-	-	2.1	-	75	32	-	-	-	-	-	300
ME	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RO	-	29*-	-	-	0.8*-	100*	-	40*	0.3*	-	35*	85*	-	-	-	-	-	150*
RS	-	29	-	-	0.8	100	-	-	36	0.3	35	85	-	-	-	-	-	140
SK	-	55	-	-	12	380	19	190	10	200	210	530	-	-	-	-	-	720
SI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*means the for Romania the following valence states: As^{3+}, Cd^{2+}, Cr^{3+}, Cr^{6+}, Cu^{2+}, Pb^{2+}, Hg^{2+}, Zn^{2+}, Ni^{2+} (Order 161/16.02.2006 pg. 119 “Elements and chemical quality standards for sediments with the granulometric fraction 63Å/m).

Table 26 - Normal content of trace elements in river sediments

Country acronym	Trace elements[µg/g] -Normal Content- River sediments																	
	Ag	As	B	Be	Cd	Cr	Co	Cu	Hg	Mo	Ni	Pb	Sb	Se	Sn	Tl	V	Zn
AT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BA-SRP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HR	-	29	-	1.1	0.8	100	-	36	0.3	3	35	85	3	0.7	-	1	42	140
DE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ME	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SK	-	29	-	1.1	0.8	100	9	36	0.3	3	35	85	3	0.7	-	1	42	140
SI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Knowledge of the contents of the major elements (Na, Ca, Mg, K etc.) characterizes the geological environment, and the traceability of these chemical elements in waters and biota is desirable.

Regarding the maximum content of major elements (Al, Ba, Fe, Mg, Mn, Na, and K) in river sediments, no country indicated these values in the questionnaires, therefore no table was made.

Table 27 - Normal content of major elements in river sediments

Country acronym	Major elements [µg/g]- Normal content - River sediments						
	Al	Ba	Fe	Mg	Mn	Na	K
AT	-	-	-	-	-	-	-
BA	-	-	-	-	-	-	-
BA-SRP	-	-	-	-	-	-	-
BG	-	-	-	-	-	-	-
HR	-	-	-	-	-	-	-
DE	-	-	-	-	-	-	-
HU	-	-	-	-	-	-	-
MD	-	-	-	-	-	-	-
ME	-	-	-	-	-	-	-
RO	-	-	-	-	-	-	-
RS	-	-	-	-	-	-	-
SK	-	160	-	-	-	-	-
SI	-	-	-	-	-	-	-
UA	-	-	-	-	-	-	-

Table 28 - Comparative list of dangerous (hazardous) substances concentration levels in sediments used in Slovakia and Serbia versus sediment quality international guides

Indicator	Dutch General Environmental Quality Standards ($mg.kg^{-1}$)			Canadian CSQG ($mg.kg^{-1}$)		Canadian PSQG ($mg.kg^{-1}$)		Slovakia Methodological instruction of the MoE No. 549/98-2 ($mg.kg^{-1}$)				Slovakia Methodological instruction of the MoE No. 549/98-2 – water solution ($mg.l^{-1}$)		Slovakia Decision No. 531/94-540 ($mg.kg^{-1}$)			Serbia Sediment quality ($mg./kg^{-1}$)		
	M	L	V	ISQG	PEL	LEL	SEL	TV	MPC	TVd	IV	TV	MPC	A	B	C	TV	MAV	RV
Metals																			
As	85	85	150	5.9	17	6	33	29	55	55	55	0.8	25	29	30	50	29	42	55
Ba	-	-	-	-	-	-	-	160	300	-	-	73	220	500	1000	2000	-	-	-
Be	-	-	-	-	-	-	-	1.1	1.2	-	-	0.02	0.2	3	20	30	-	-	-
Cd	2	7.5	30	0.6	3	0.6	10	0.8	12	7.5	12	0.08	0.4	0.8	5	20	0.8	6.4	12
Co								9	19	-	-	0.2	2.8	20	50	300	-	-	-
Cr	480	480	103	37.3	90	26	110	100	380	380	380	0.2	8.7	130	250	800	100	240	380
Cu	35	90	400	35.7	197	16	110	36	73	90	190	0.4	1.5	36	100	500	36	110	190
Hg	0.5	1.6	15	0.17	0.486	0.2	2	0.3	10	1.6	10	0.01	0.2	0.3	2	10	0.3	1.6	10
CH3Hg	-	-	-	-	-	-	-	0.3	1.4	-	-	0.01	0.02	-	-	-	-	-	-
Mn	-	-	-	-	-	460	1100	-	-	-	-	-	-	-	-	-	-	-	-
Mo	-	-	-	-	-	-	-	3	200	-	-	2.9	290	1	40	200	-	-	-
Ni	35	45	200			16	75	35	44	45	210	3.3	5.1	35	100	500	35	44	210
Pb	530	530	103	35	91.3	31	250	85	530	530	530	0.2	11	85	150	600	-	-	-
Sb	-	-	-	-	-	-	-	3	15	-	-	0.3	6.5	-	-	-	-	-	-
Se	-	-	-	-	-	-	-	0.7	2.9	-	-	0.05	5.3	0.8	5	20	-	-	-
Sn	-	-	-	-	-	-	-	-	-	-	-	0.2	18	20	50	300	-	-	-

Indicator	Dutch General Environmental Quality Standards ($mg.kg^{-1}$)			Canadian CSQG ($mg.kg^{-1}$)		Canadian PSQG ($mg.kg^{-1}$)		Slovakia Methodological instruction of the MoE No. 549/98-2 ($mg.kg^{-1}$)				Slovakia Methodological instruction of the MoE No. 549/98-2 – water solution ($mg.l^{-1}$)		Slovakia Decision No. 531/94-540 ($mg.kg^{-1}$)			Serbia Sediment quality ($mg./kg^{-1}$)		
	M	L	V	ISQG	PEL	LEL	SEL	TV	MPC	TVd	IV	TV	MPC	A	B	C	TV	MAV	RV
Tl	-	-	-	-	-	-	-	1	2.6	-	-	0.04	1.6				-	-	-
V	-	-	-	-	-	-	-	42	56	-	-	0.8	4.3	120	200	500	-	-	-
Zn	480	103	2500	123	315	120	820	140	620	720	720	2.8	9.4	140	500	3000	140	430	720
Inorganic compounds																			
P total	-	-	-	-	-	600	2000	-	-	-	-	-	-	-	-	-	-	-	-
F total	-	-	-	-	-	-	-	-	-	-	-	-	-	500	1000	2000	-	-	-
S sulphide	-	-	-	-	-	-	-	-	-	-	-	-	-	2	20	200	-	-	-
Br total	-	-	-	-	-	-	-	-	-	-	-	-	-	20	50	300	-	-	-

Explanations:

TV – target value – negligible risk, undisturbed natural environment, uncontaminated sediment and 100% survival of aquatic organisms, represents 1/100 MPC);
MPC – maximum permissible concentration – represents the maximum permissible risk, the level ensuring the survival of 95% of all species of organisms in the given ecosystem;
TVd – tested value – the environmental risk is not expressed, the value lies in the interval between MPC and IV can be used for deciding on sediment management;
IV – intervention value – represents a serious risk; the concentration of a substance in which only 50% of all species of the ecosystem are protected;
A – reference value,

B – indication value (if value exceeded, site monitoring is required),
C – intervention value (if value exceeded, remediation measures are required);
MAV-maximum allowed value;
RV-remediation value (intervention value)

Canadian CSQG means Canadian Environmental Quality Guidelines.
Canadian PSQG means Provincial Sediment Quality Guideline.
Lowest Effect Level (LEL): indicates a level of contamination that can be tolerated by the majority of sediment dwelling organisms. Sediments meeting the LEL are considered clean to marginally polluted.
Severe Effect Level (SEL): indicates a level of contamination that is expected to be detrimental to the majority of sediment dwelling organisms. Sediments exceeding the SEL are considered heavily contaminated.
ISQG = interim sediment quality guideline.

In the list of dangerous substances (molecular compounds) in soils, all partner countries took into account (besides the chemical elements (heavy metals, non-metals) and their molecular compounds that are known to be sometimes more toxic than the elements as such), other molecular compounds: polycyclic aromatic hydrocarbons - PAHs, polychlorinated biphenyls -PCBs, insecticides based on chlorinated hydrocarbon, herbicides, or the particular values of each component. A large number of other parameters are laid down in legislation for both water and soils.

For many categories of soils and use of sediments, surface waters, underground waters, a long list of organic substances is included in national legislations that contributes to the establishment of quality classes for aquatic or terrestrial ecosystems. A list of these substances, including the maximum and normal values (as it was done in this report for metals and some toxic nonmetals) is difficult to achieve because of the dissimilar national legislations.

A short list found in most of the questionnaires (according to Annexes 2-15) includes:

-**16 PAHs** - mononuclear and polynuclear aromatic compounds (Benzen, Etil-benzen, Toluen, Xilen, Stiren, Fenol, Benz(a)piren, Naftalina, Antracen, Fenantren, Fluoranten, Benzo(a)antracen, Crisen, Benz(ghi)perilen, Indeno(1,2,3-cd)piren, Benz(k)fluoranten).
-**7 PCBs** Bifenilipoliclorurat (PCB28, PCB52, PCB101, PCB118, PCB138, PCB153, PCB180)
-**11 pesticides** gamma-HCH (lindan); HCH (suma alfa-, beta-, delta-HCH); DDT/DDD/DDE (suma); Aldrin; Dieldrin; Endrin; Drinuri (as sum) Atrazin; Endosulfan; Heptaclor; organo-stanic coumpounds.

For this abridged list, it is necessary to compare the maximum and normal values as set out in the national legislations, in the EU-WDF and in the Sediment Quality Guides.

It is worth mentioning that in the aquatic environment the danger of chemical elements resulting from biochemical activity must be analyzed for establishing the list of hazardous substances.

For drinking water or bathing water all countries have threshold values of microbiological indicators, such as *Intestinal Enterococci* [CFU/100 ml] and *Escherichia coli* [CFU/100 ml]. A series of aditional bacteria are foreseen in the questionnaires.

I.3. Quality objectives for hazardous substances

The surface or groundwater bodies' quality is established on the basis of the values of certain parameters and the classification is adopted by the majority of SIMONA countries. An example is presented in Table 29.

Table 29 – Example of water body classification into four categories based on chemical and physical parameters

Yearly average threshold limit values for surface water and quality standards for water biota - Croatia

Indicator	very good	good	moderate	bad
Transparency [m]	> 10	< 10	< 3	< 3
Oxygen saturation [%]	80 – 120	surface layer: 120 – 170 bottom layer: 30 – 80	surface layer: > 170 bottom layer: 30 – 80	surface layer: > 170 bottom layer: 0 – 30
Dissolved anorganic nitrogen [µmol/l]	< 2	< 10	< 20	> 20
Dissolved phosphorous [µmol/l]	< 0.3	< 0.6	< 1.3	> 1.3
Chlorophyll a [µ/l]	< 1	< 5	< 10	> 10
TRIX	2 – 4	4 – 5	5 – 6	6 – 8

For soils, the classifications are dependent on the purpose (generally soils for agriculture).

Some national legislation specifies the use, others only establish 2-4 soil categories, the first being the one with normal values of the environmental background, and the last being the one with values that require the intervention of the authorities. There are also laws that classify soils.

Classes of sediment quality are provided only by Serbia (3 classes) and Slovakia (4 classes). In Romania one of these classes is the intervention class. The remedies are not explicitly formulated for this class in Romania.

I.4. Listing of analytical standards

The chapter regards national analytic and international standards (e.g. USEPA, ASTM, etc.) recommended in documents for chemical, physical, microbiological analyzes of samples.

Most of the guidelines for water, soil, sediment, and water quality have recommendations on sampling, transport, storage and analysis (the type of analytical technique) for each toxic parameter. For example, for metals analysis in waters in Romanian legislation, the ICP - MS is recommeded, or the AAS technique for "total metals" analysis. Any other technique (detection limits, precision, and accuracy) is accepted. Analytical laboratories must be accredited (certified) by the authorities. In all questionnaires the analytical standards under which analyzes were performed are mentioned for dangerous substances in detail for each parameter and the type of matrix in which the equipment is being used. Chapter 2.IV mentions also the equipment to be used (Table 37).

Analytical methods, equipment type and description of procedures are provided in additional legislation (ISO, EPA, etc.) and these are listed by all partners in detail. In addition to national legislation, all partners listed international regulations.

I.5. List of chronic or acute toxicity tests and biota

The purpose of this question was to find out information about lists of chronic or acute toxicity tests and determination of bioaccumulation or persistence in biota according to the specificity of the dangerous substance in the trophic chain (e.g.: Microtox test - The potential ecological impacts of anaerobic degradation of vegetable oil on freshwater sediments; Hyalella Azteca etc).

Austria's questionnaire (Annex 2) points out the following links for toxical data:

- Priority Compound dossiers:

    - § Dossiers 2012: https://circabc.europa.eu/w/browse/2266abad-7e2f-4380-83b8-623c5526d3f6
    - § Dossiers 2006: https://circabc.europa.eu/w/browse/8d2c7c28-358e-4ddf-8a0e-149f6667c19f
- Priority Draft Dossiers: https://circabc.europa.eu/w/browse/83a33797-b5fe-47ea-810a-a98ce3f12146
- Data Base UBA-DE ETOX: https://webetox.uba.de/webETOX/public/search/ziel/open.do
- Registration REACH ECHA-DB: https://echa.europa.eu/de/information-on-chemicals/registered-substances
- Dossiers after PSM and Biocide-Products VO: https://efsa.onlinelibrary.wiley.com/#

Chronicle and acute assessment for water are done in Germany, the Netherlands and Switzerland:

- DE: https://webetox.uba.de/webETOX/public/search/ziel/open.do
- NL: https://rvszoeksysteem.rivm.nl/
- CH: https://www.oekotoxzentrum.ch/expertenservice/qualitaetskriterien/qualitaetskriterienvorschlaege-oekotoxzentrum/

In Slovakia (Annex 13) the determination of ecotoxicity is usually done in two ways. These can be extractions that determine bioavailable concentration which is comparable to the limit values for ecotoxicity. Secondly, direct ecotoxicological tests are carried out under laboratory conditions on real test microorganisms. Ecotoxicological tests on aquatic organisms (*Poecilia reticulata*, *Daphnia magna*, *Sinapis alba*, *Scenedesmus quadricauda*, *Desmodesmus subspicatus*) determine the IC50 or EC50 values according to the declaration STN 83 8303 and they subsequently determine whether the sewage is dangerous or inert on the basis of leachability.

I.6. List of national and international guides of techniques

This chapter regarded the lists of national, and international guides of techniques on the design of sampling, transport, storage, samples preparation (sieving, fraction extraction, separation, etc.) recommended in documents.

Most of the questionnaires do not specify whether the standards (sampling, handling, preservation, screening, laboratory analysis for water, soil, sediment, biota samples) are mandatory in national legislation.

For example, the ICP-MS method and the AAS method for water analysis are recommended in Romania (Order no.161/2006), but mandatory analytical standards are not specified in this law.
Based on the data provided in the questionnaires, these standards are listed in Table 33 at the end of Chapter III.
In chapter 2.IV there are specified the analytical standards corresponding to all methods of analysis (IV.2.2 – IV.2.8). For soils more guides were listed.
The sampling strategies listed in table 34 for water, sediments and biota were mentioned by the majority of country partners.

The data used in assessing the ecological and chemical status should come from composite samples, in accordance with the minimum recommendations regarding the collection of composite samples, their transport and storage contained in the series SR ISO 5667/2002. In case of using other standards of collection, transport and storage, these should reach at least the same precision and accuracy performances as the recommended standard.

The values of the foreseen indicators will be settled by means of analyses and measurements, performed in laboratories certified for the environmental field, using the national or European standards recommended for the respective indicator.

I.7. Recommended remedy measures

This question regarded the recommended remedy measures associated with the contents of the hazardous substances (alert threshold, intervention threshold) defined at point I.2 in the questionnaire (Annex 1).

National legislations do not foresee remedial measures. There are indicated only the criteria to establish the poor quality of the analyzed environmental element, as well as its classification into the "intervention class" (name generally used by all partner countries).
The information available in the literature may be a support for the recommendation (in line with the Danube basin characteristics) of measures in the preparation of the guide.

In Bulgaria, in case of damaged terrains, recultivation projects according to the related Environmental laws are implemented and the following steps are taken:
1. Analysis of the damaged area;
2. Detailed investigation including environmental risk assessment and human health risk assessment;

3. Design and implementation of projects for restoration of damaged areas;
4. Monitoring and maintenance of the functions of the restored areas.

For the Republic of Moldavia there are no specific measures for the polluted sites remediation. The procedure of informing the local and central authorities, relevant institutions on the pollution cases and the calculation of taxes for environmental damages is regulated.

In Serbia the remedy actions are defined according to the situation. The recommended remedy measures are defined by the Water Act, as well as the Draft Water Protection Plan which defines:

- measures for control, prevention, cessation and lowering of the amount of polluting and hazardous substances entering surface and groundwaters;
- measures for prevention of storage and depositing of waste materials in areas where this waste could have a negative influence on the quality of surface and groundwaters;
- measures for treatment of wastewaters;
- measures for prevention of non-point source pollution;
- measures for protection of aquatic ecosystems and other ecosystems which directly depend on aquatic ecosystems;
- measures for protection of aquatic ecosystems from hazardous polluting substances;
- manner in which interventions are carried out in specific cases of pollution;
- responsible parties which must ensure that these measures and interventions are carried out.

Serbia is part of the International Commission for the Protection of the Danube River (ICPDR). This international organization consists of 14 cooperating states and the European Union. The commission has a manual for the accident warning system which also applies for Serbia (***AEWS*** -- International Operations Manual for Principal International Alert Centres of the Danube **Accident Emergency Warning System**).

In Romania, according to Order no. 161/2006 art. 2.5, the recommendations measures indicate that “in cases where the chemical pollution is responsible for environmental damage (and not the works that modify the hydromorphological elements), the chemical pollutant or pollutants causing damages must be established, in order to act on the level of the pollutant such as to reduce its impact, highlighted by overpassed quality standard”.

II. PRACTICES, EXPERIENCES

II.1. Significant projects

Based on the answered questionnaires, histograms of significant projects carried out in different countries of the Dabube Basin regarding the geochemistry of waters, soils and sediments were computed (Fig. 1).

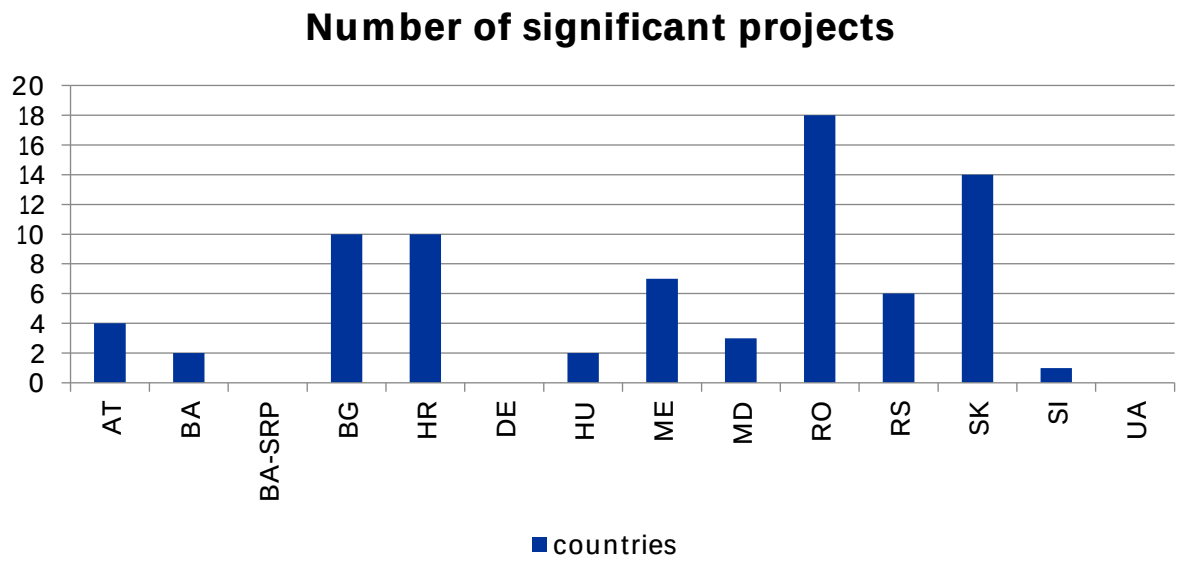


Fig. 1. Number of significant projects regarding the Danube Basin

Most of the partner countries are completely situated in the Danube Basin, but others (e. g. Germany, Ukraine) cover rather small areas of this Basin. Probably, not all project information was available at the date of filling the questionnaire. Table 30 presents some of the projects where more SIMONA countries took part.

Table 30 – Joint projects carried out in the Danube Basin

Project Title	Period	Participant Countries
WATER	2007 - 2013	Bulgaria, Romania
Joint Danube Survey 1, 2, 3	2001, 2007, 2013	ICPDR
Romanian-Bulgarian cross-border joint natural and technological hazards	2007 - 2013	Romania, Bulgaria

Project Title	Period	Participant Countries
assessment in the Danube Floodplain – ROBUHAZ-DUN		
Danube Floodplain	2018 - 2020	Romania, Austria, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Slovakia, Slovenia, Serbia
Sustainable management of sediment resources (SedNet)	2002 - 2004	EUROPE(SedNetwork (https://sednet.org/)
FOREGS Geochemical mapping of Europe	1998 - 2005	Europe European Geological Surveys (EGS)
Geochemical Mapping of Agriculture and Grazing Land Soil in Europe (GEMAS)	2008 - 2014	Europe European Geological Surveys (EGS)
Trans-boundary contamination risk assessment and modelling for sustainable soil management, food safety and natural riverine habitat protection in the Drava River floodplain	2017 - 2018	Slovenia, Hungary
Reinforcing S&T Capacities of Two Emerging Research Centers for Natural and Industrial Pollutant Materials in Serbia and Slovenia (RESTCA-TERCE-NIPMSS	2008 - 2011	Slovenia, Serbia
HydroMorphological assessment and management at basin scale for the Conservation of Alpine Rivers and related Ecosystem Services (HyMoCARES) https://www.alpine-space.eu/projects/hymocares/en/home	2016 - 2019	Croatia,Italia
Sava River Basin: Sustainable Use, Management and Protection of Resources	2004 - 2007	Slovenia, Croatia, B&H, Serbia
DanubeSediment „Danube Sediment Management - Restoration of the Sediment Balance in the Danube River“	2017 - 2019	Hungary, Austria, Romania, Germany, Bulgaria;, Croatia; Slovenia, Slovakia; Germany, Serbia
FramWat „Framework for improving water balance and nutrient mitigation by applying small water retention measures“	2017 - 2020	Poland, Slovakia,Hungary, Slovenia, Croatia, Austria

II.2. Significant papers

Significant scientific papers and books related to geochemistry of water, soils and sediments in the Danube Basin were requested in the inventory questionnaire. Based on the answers histograms were computed (Fig. 2).

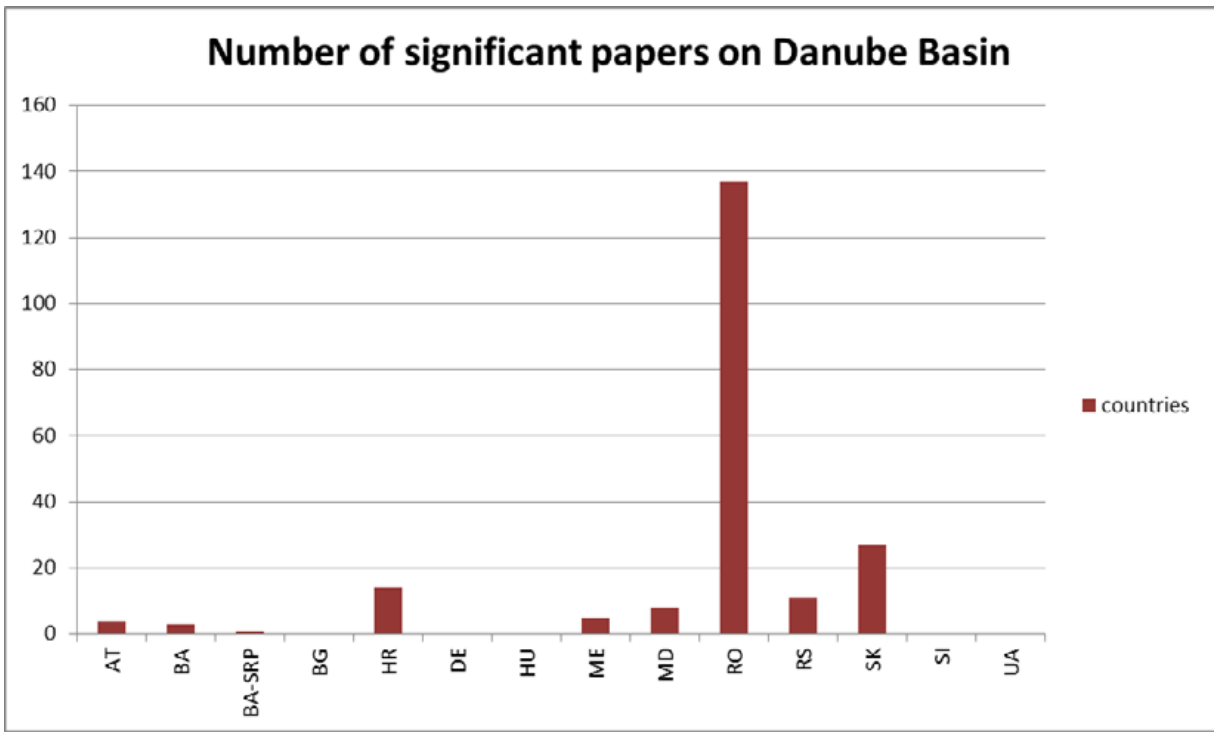


Fig. 2 Number of significant papers on Danube Basin

In Romania, the large number of papers (137), are added separately in a list attached to the questionnaire. The other partner countries have also numerous papers on this topic, but they reduced the number in order to be compatible with the questionnaire table.

Table 31 lists guides and books published on the topic of monitoring the Danube Basin, some of them produced within the framework of common projects in this region.

Table 31 – Selected representative guides and books for the monitoring of the Danube Basin

Title	Publication Year	Covered Territory	Authors
FOREGS Geochemical Mapping Field manual	1998	Europe	Salminen, R. et al.
Geochemical Atlas of Europe-Part 1	2005	Europe	Salminen, R. et al
Geochemical Atlas of Europe-Part 2	2006	Europe	De Vos, W. et al.
EuroGeoSurveys Geochemical mapping of agricultural and grazing land soil of Europe (GEMAS) - Field manual	2007	Europe	EuroGeoSurveys Geochemistry Working Group
Sediment quality and impact assessment of pollutants	2008	Europe	Barcelo, D, & Petrovic, M.
Chemistry of Europe's Agricultural Soils-Part A	2014	Europe	Reimann, C. et al.
Chemistry of Europe's Agricultural Soils-Part B	2014	Europe	Reimann, C. et al.
EuroGeoSurveys Geochemical mapping of agricultural and grazing land soil of Europe (GEMAS) - Field manual	2008	Europe	EuroGeoSurveys Geochemistry Working Group
Geokemijski atlas Hrvatske (Geochemical Atlas of Croatia)	2009	Croatia	Halamić, j. & Miko, S. (eds)
Geokemijski atlas Siska (Geochemical Atlas of Siska)	2014	Croatia	Šorša, A. & Halamić, J
Assessment of the natural and anthropogenic sources of chemical elements in alluvial soils from the Drava River using multivariate statistical methods	2011	Slovenia, Croatia	Šajn, R., Halamić, J., Peh, Z. Galović, L., Alijagić, J.
Handbook for Sediment Qulity Assessment	2005		Simpson et al.
Monitoring Pesticide Residues in Surface and Ground Water in Hungary: Surveys in 1990–2015	2015	Hungary	Székács, A., Mörtl, M. & Darvas, B
2nd Sava River Basin Analysis Report	2016	Croatia	International Sava River Basin Commission

II.3. Monitoring sites

This chapter refers to existent waterbodies and sampling sites (Ramsar, Natura2000 etc.) and current quality monitoring stations of the Danube River

Current quality monitoring stations of the Danube River, together with existent waterbodies and sampling sites were provided by every country. All countries provided tables with monitoring sites, their coordinates (in geographical system WGS84 or in national system), accompanied by the river or site name. Austria provided the requested monitoring stations on the Danube River already as ESRI shapefiles.

Some countries, as Croatia, Slovenia, Bosnia and Herzegovina (Federation of Bosnia and Herzegovina), Serbia, Bulgaria and Ukraine provide also some attributes, distinguishing for example between monitoring stations for sediments, for river water, for the Trans National Monitoring Network (TNMN), or between monitoring HSs stations in sediments and in biota. All the atributes are listed in the annexes of the respective countries.

For some countries, (Austria, Germany), the provided monitoring stations were only along the Danube, while for others (Slovenia, Bosnia and Herzegovina, Montenegro, Ukraine), the stations referred only to the tributaries. There is also the third categories of countries which have Danube crossing or as a border of their territory (Bulgaria, Croatia, Hungary, Romania, Serbia, Slovakia and the Republic of Moldavia), which provided alo monitoring stations for some tributaries. For example, In Romania there are listed and represented, besides the monitoring stations on the Danube, also those in the Somes – Tisa basin, which is a test zone of SIMONA project.

For making up the maps, the Catchment Characterisation and Modeling database CCM version 2.1 of the Joint Research Centre of the European Commission was used. The respective dataset for the Danube Catchment had been produced in 2005 in the Lambert Equal Area projection (ETRS 1989 LAEA). The detailed description of the whole European dataset can be found in (Vogt et al., 2007).

The countries borders (Fig. 3) were downloaded from the EUROSTAT EC site at:

https://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/administrative-units-statistical-units/countries

For the map physical background OpenStreets data were used. For each contry a map was computed based on the provided monitoring stations and these are presented in Figures 4 – 17. Per total, there were provided 1293 monitoring stations in SIMONA countries questionnaires.

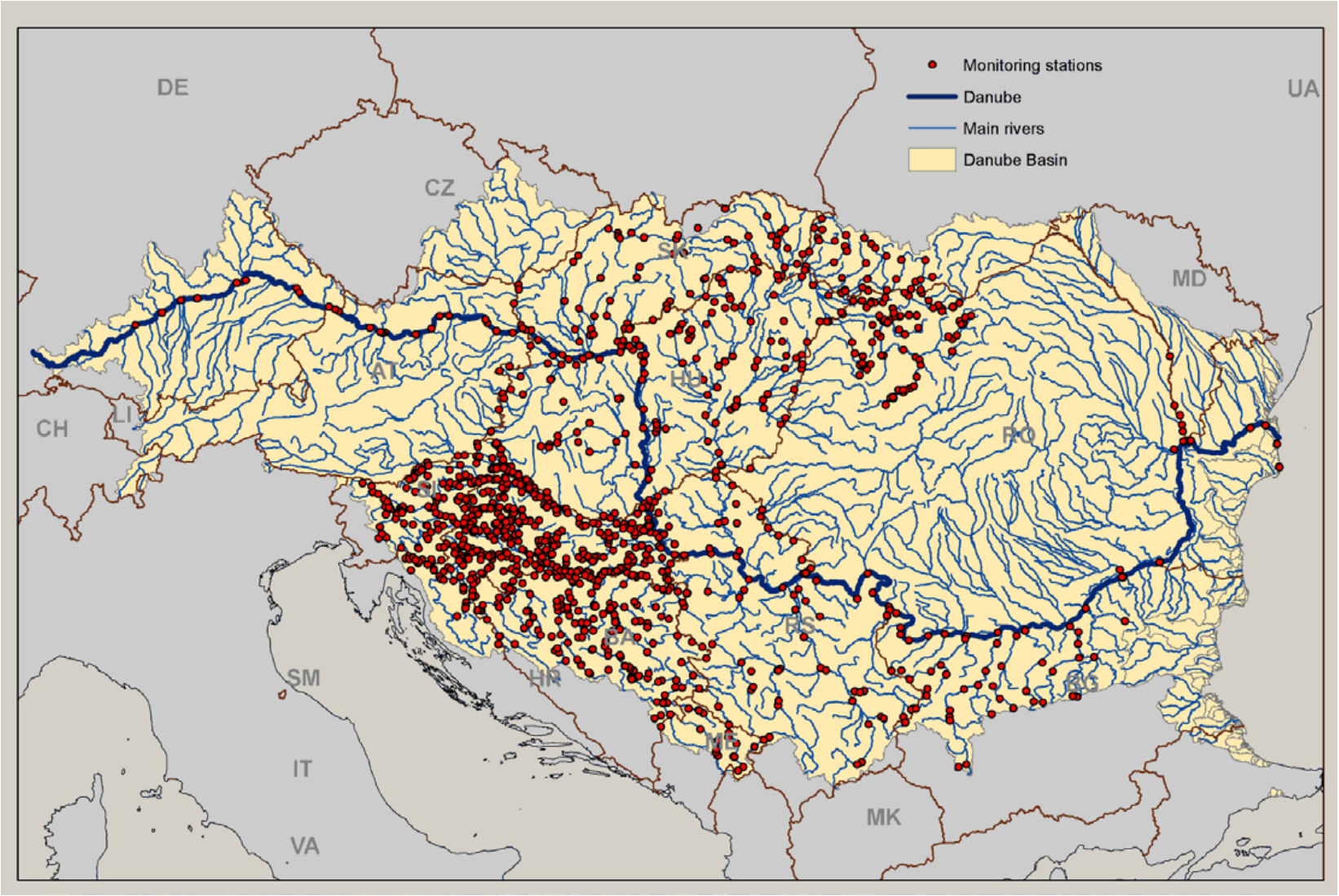


Fig.3 Monitoring stations in SIMONA project countries of the Danube River Basin

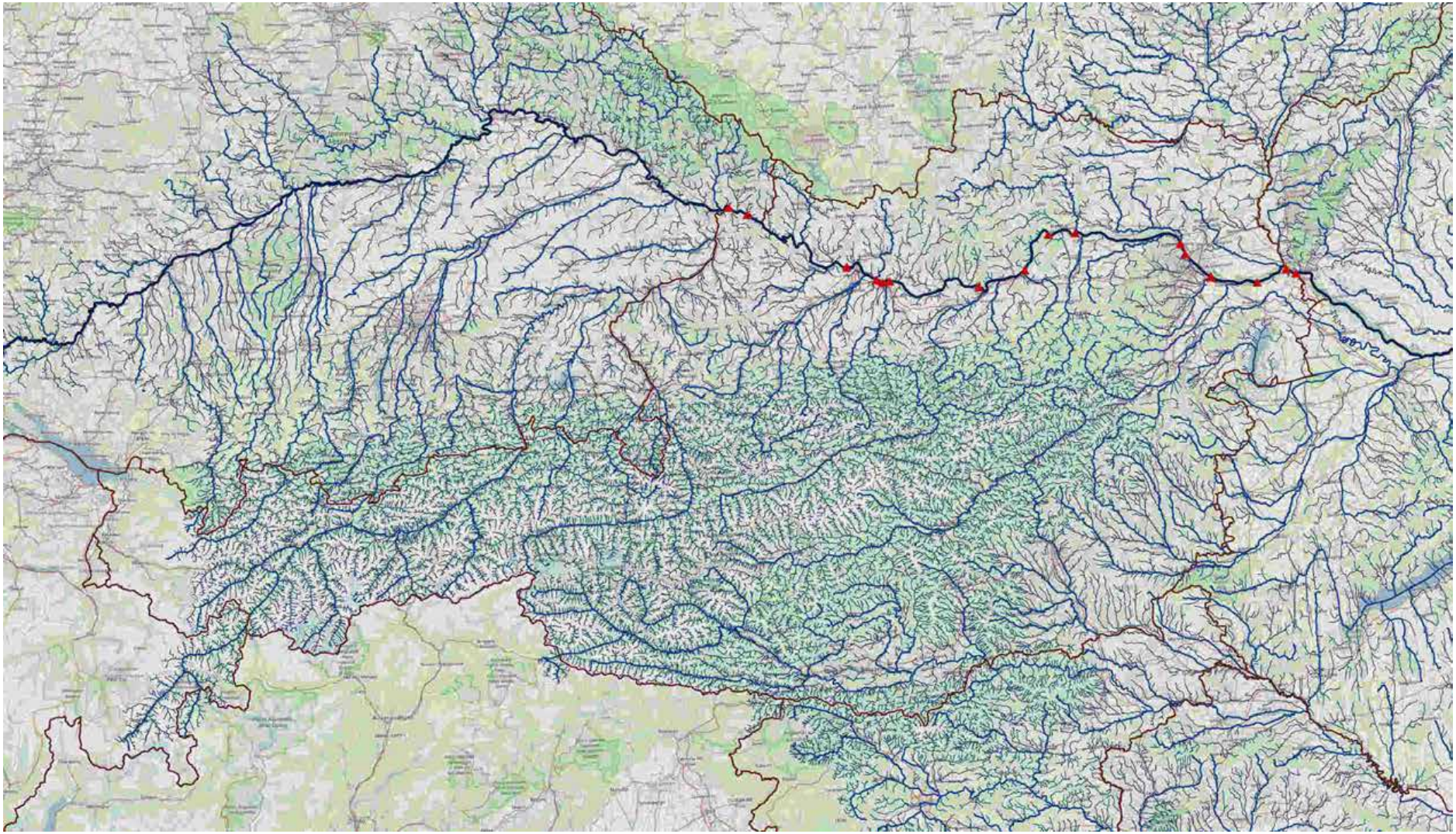


Fig.4 Monitoring stations on the Danube River in Austria

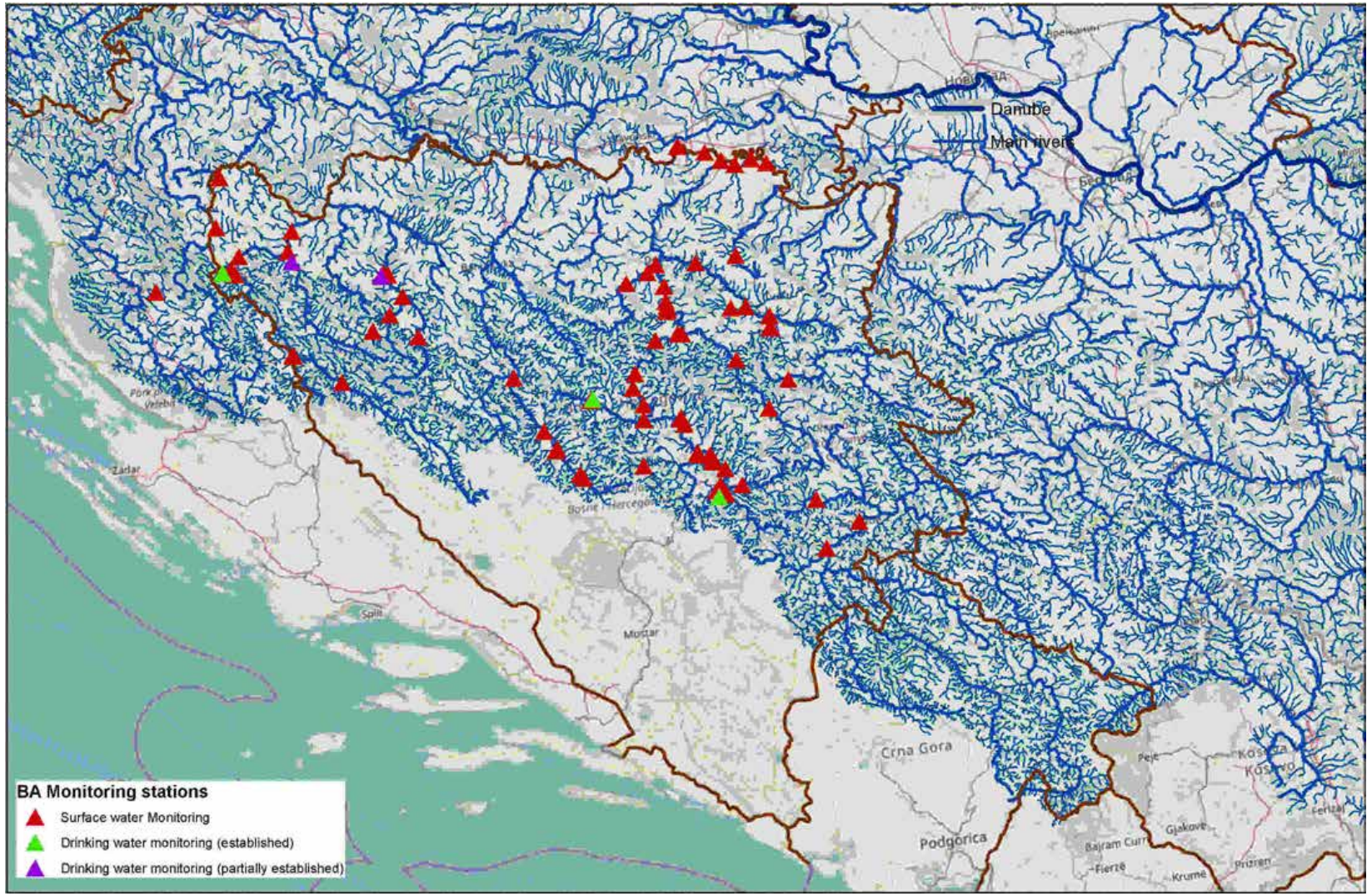


Fig.5 Monitoring stations on the Danube River tributaries in Bosnia-Herzegovina (BiH – Federation of Bosnia and Herzegovina)

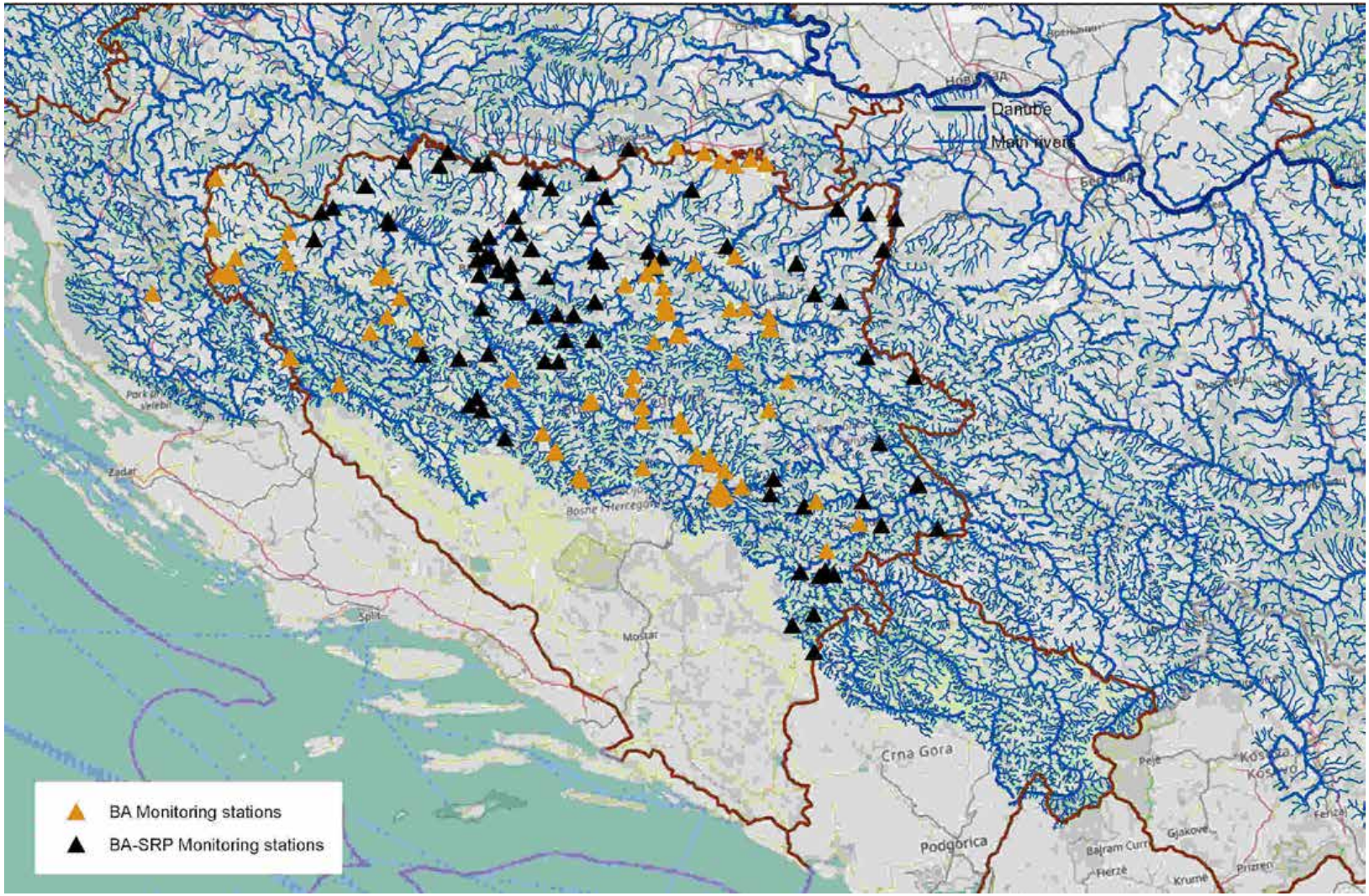


Fig.6 Monitoring stations on the Danube River tributaries in Bosnia-Herzegovina (Federation of Bosnia and Herzegovina, Republic of Srpska)

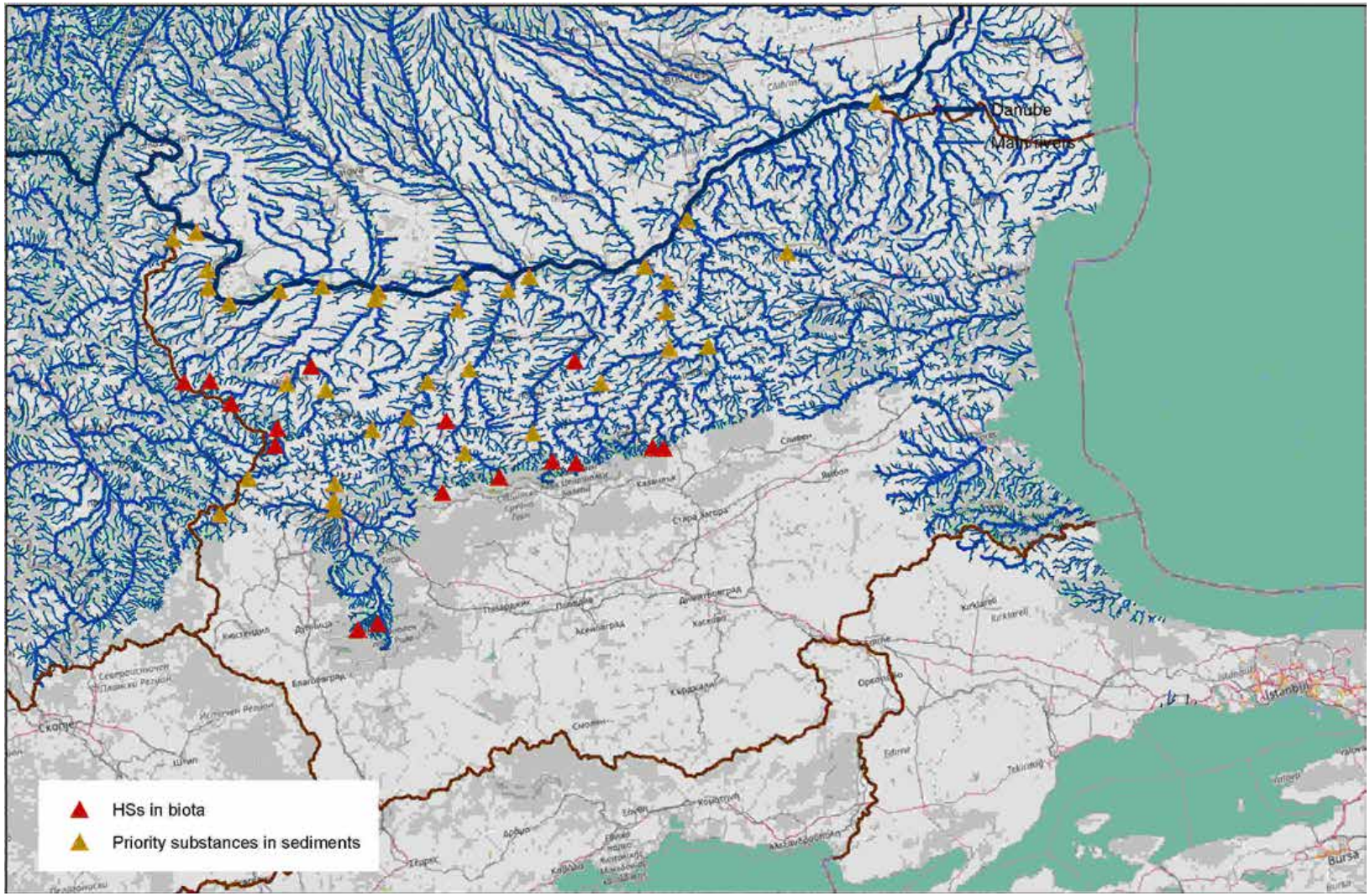


Fig.7 Monitoring stations on the Danube River and its tributaries in Bulgaria

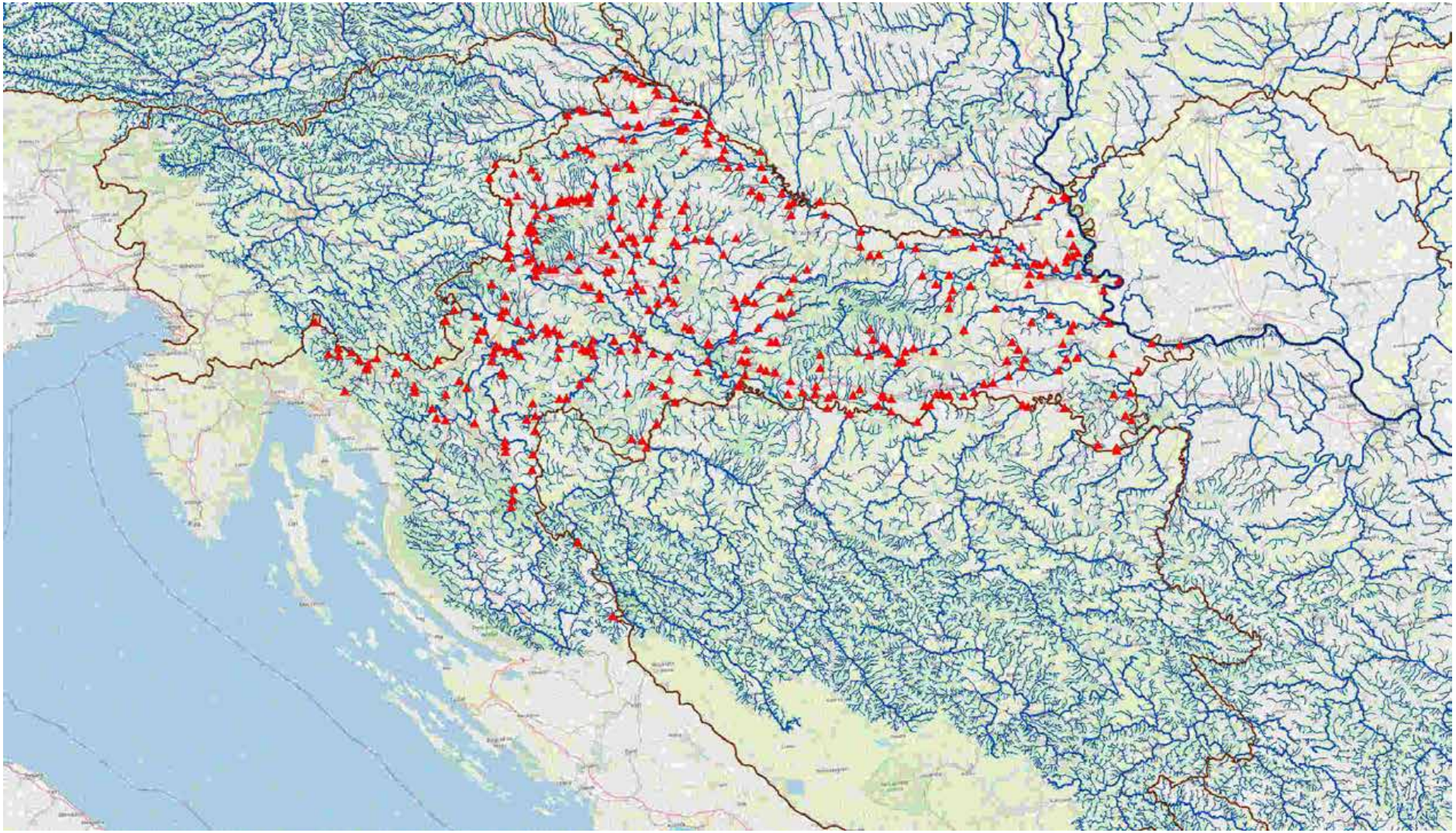


Fig.8 Monitoring stations on the Danube River tributaries in Croatia

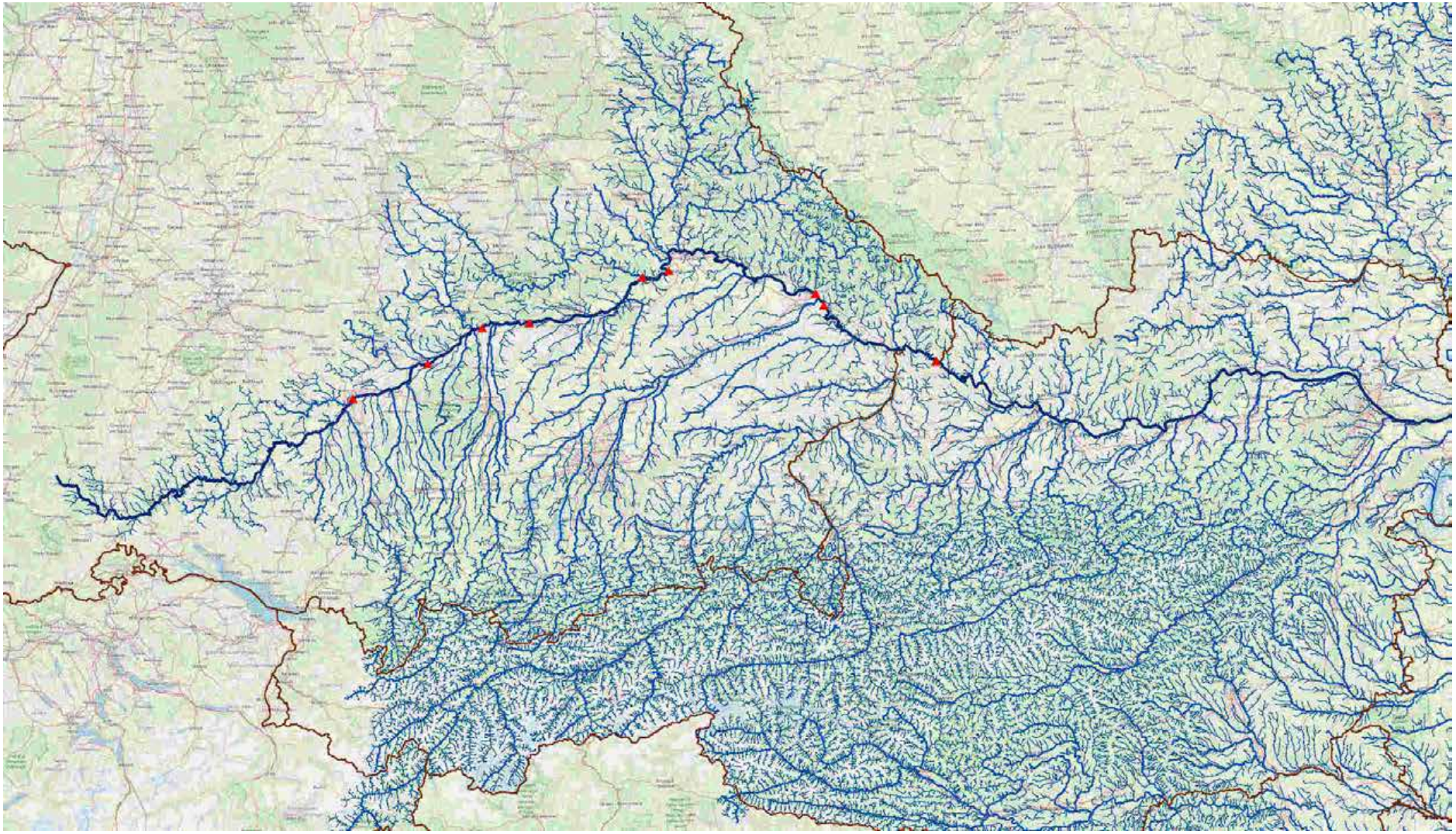


Fig.9 Monitoring stations on the Danube River in Germany

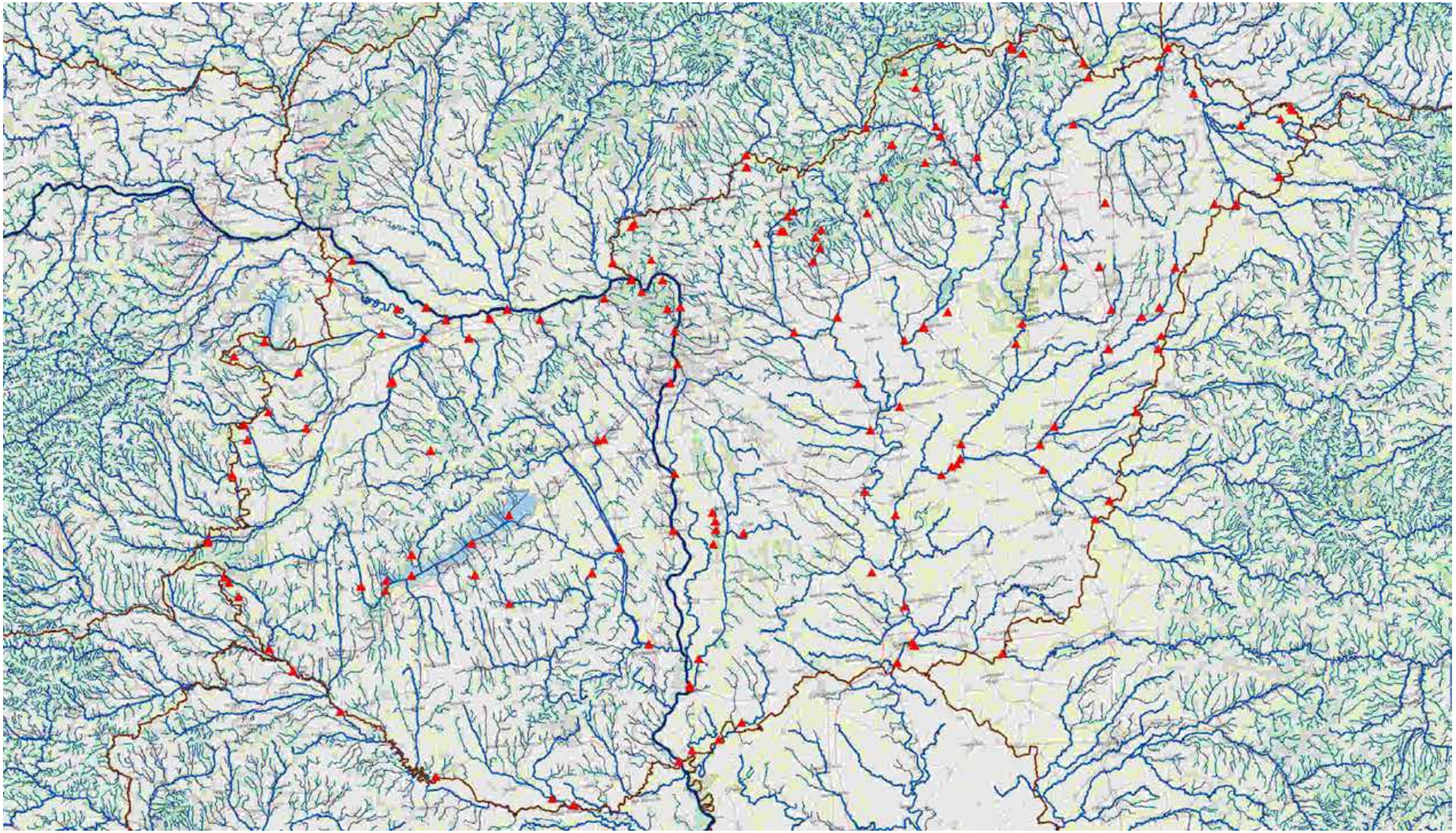


Fig.10 Monitoring stations on the Danube River and its tributaries in Hungary

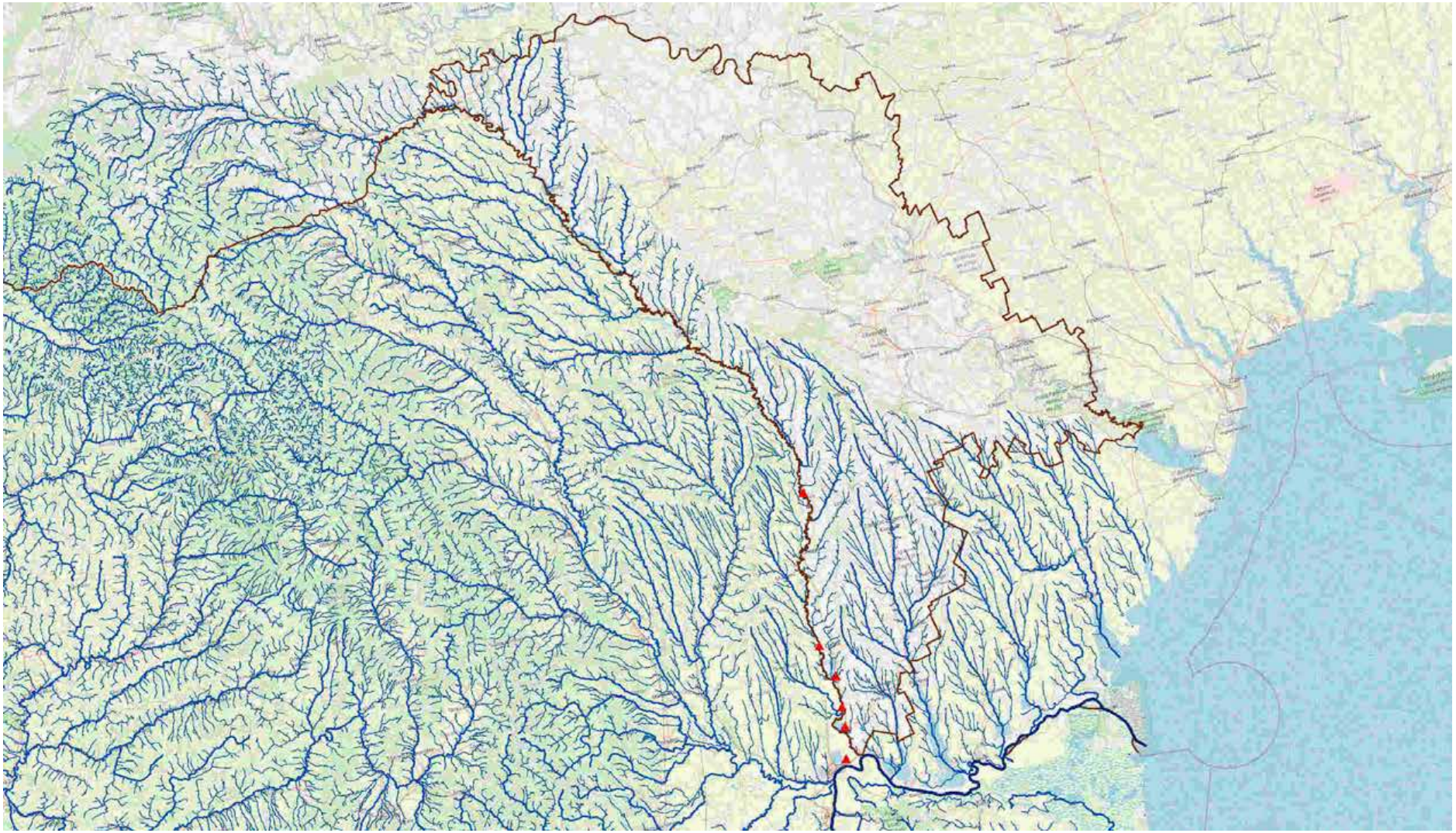


Fig.11 Monitoring stations on the Danube River tributaries in the Republic of Moldavia

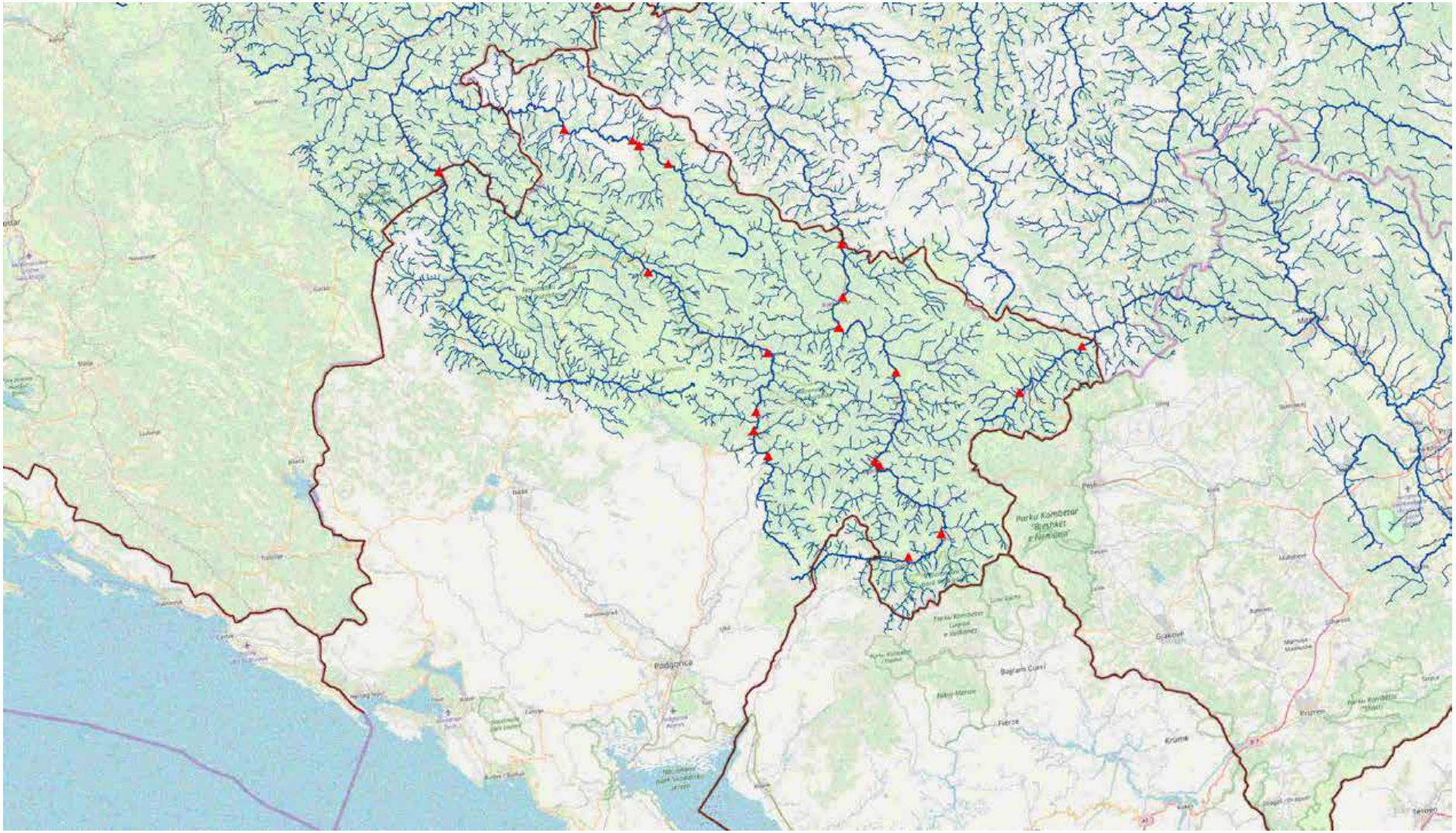


Fig.12 Monitoring stations on the Danube River tributaries in Montenegro

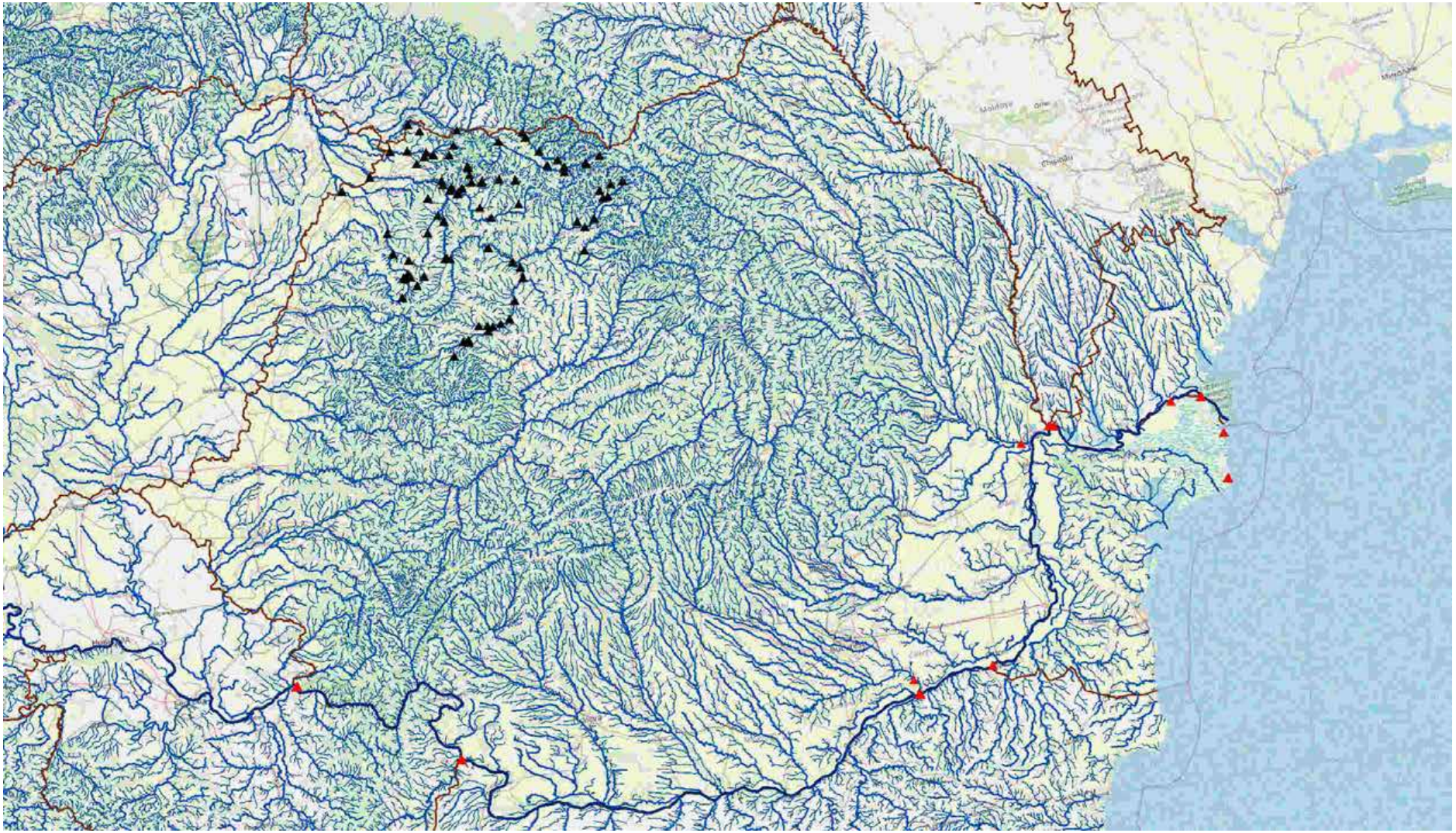


Fig.13 Monitoring stations on the Danube River and its tributaries (Somes – Tisa) in Romania

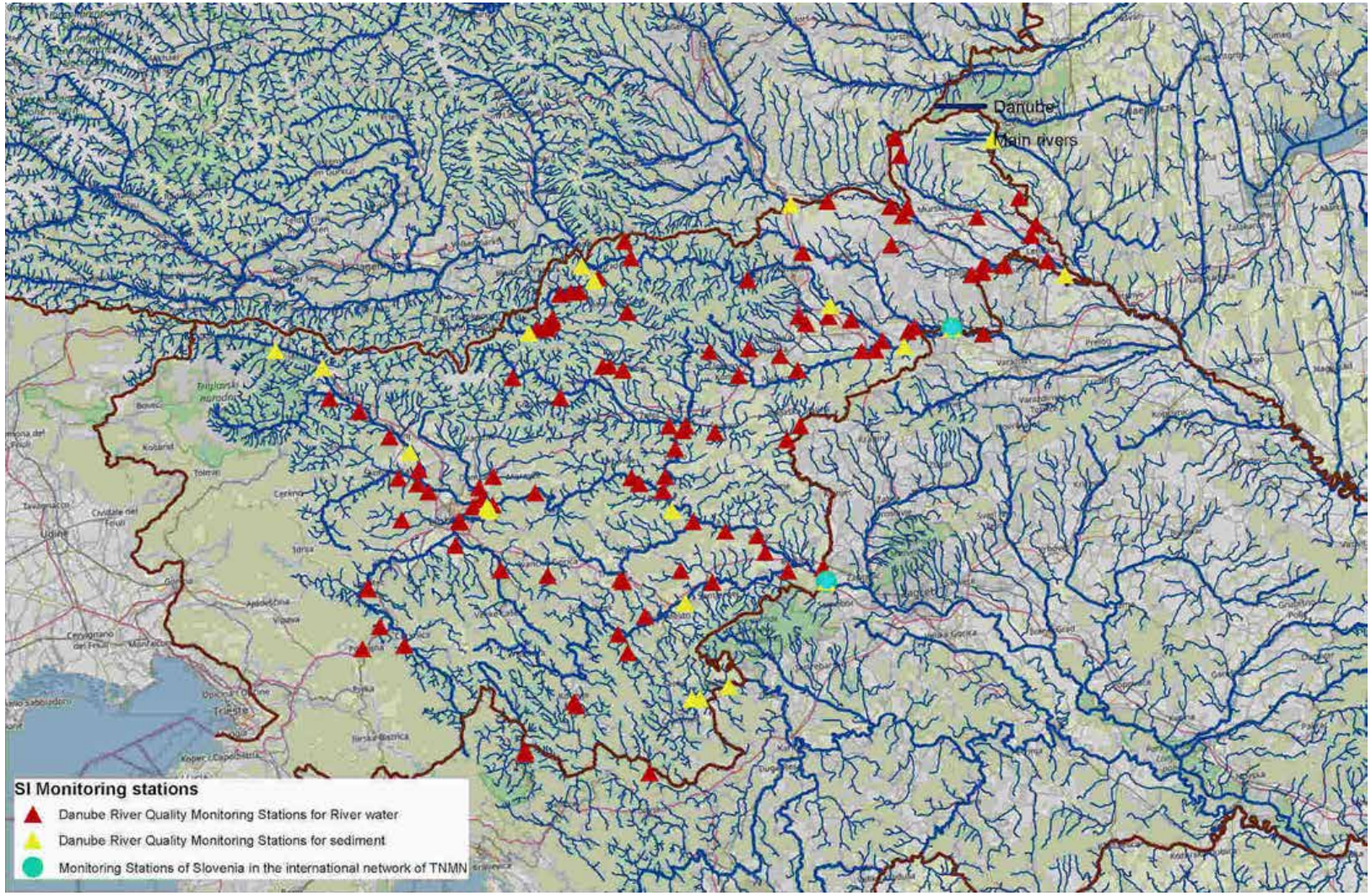


Fig.14 Monitoring stations on the Danube River tributaries in Slovenia

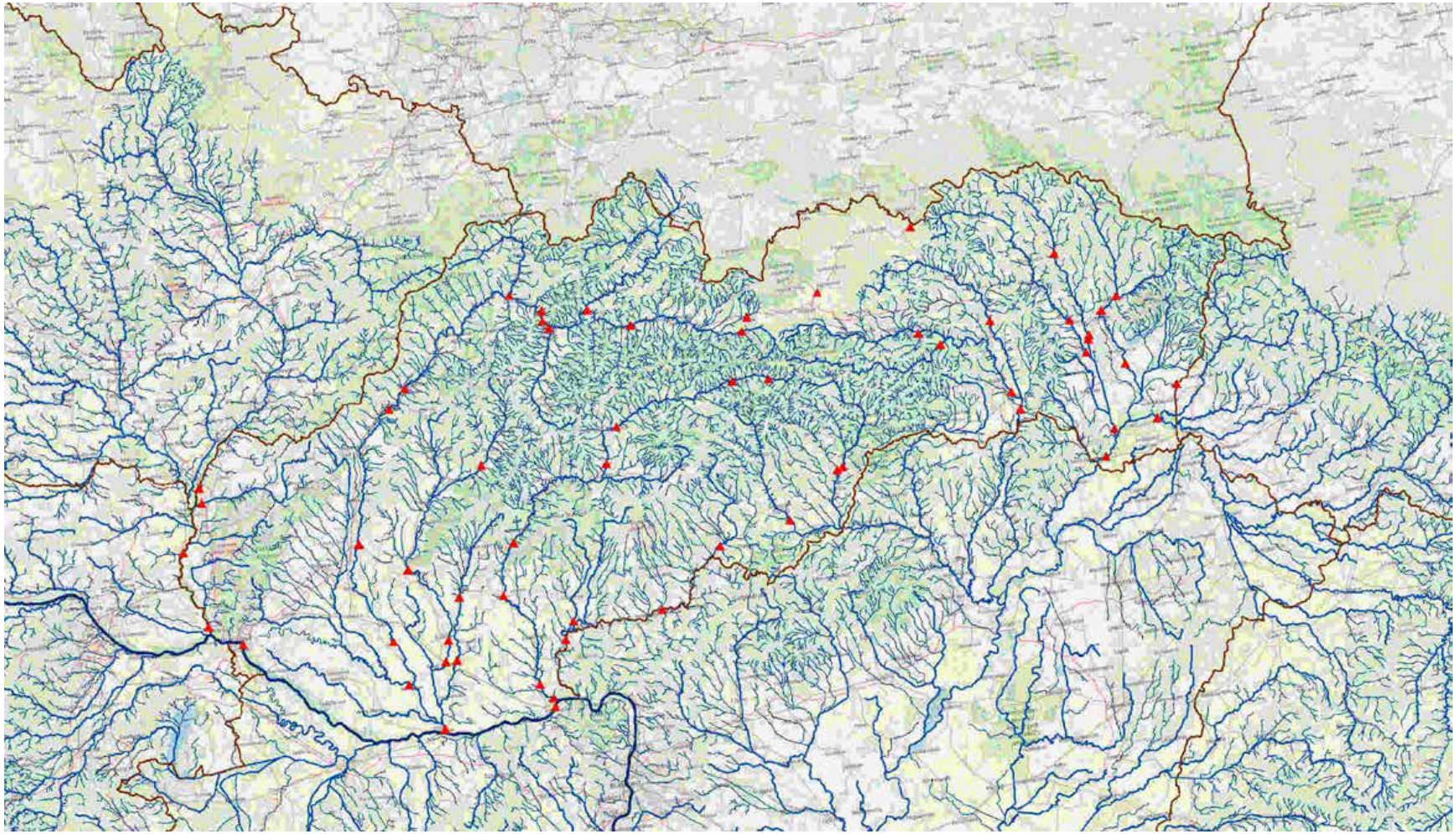


Fig.15 Monitoring stations on the Danube River and its tributaries in Slovakia

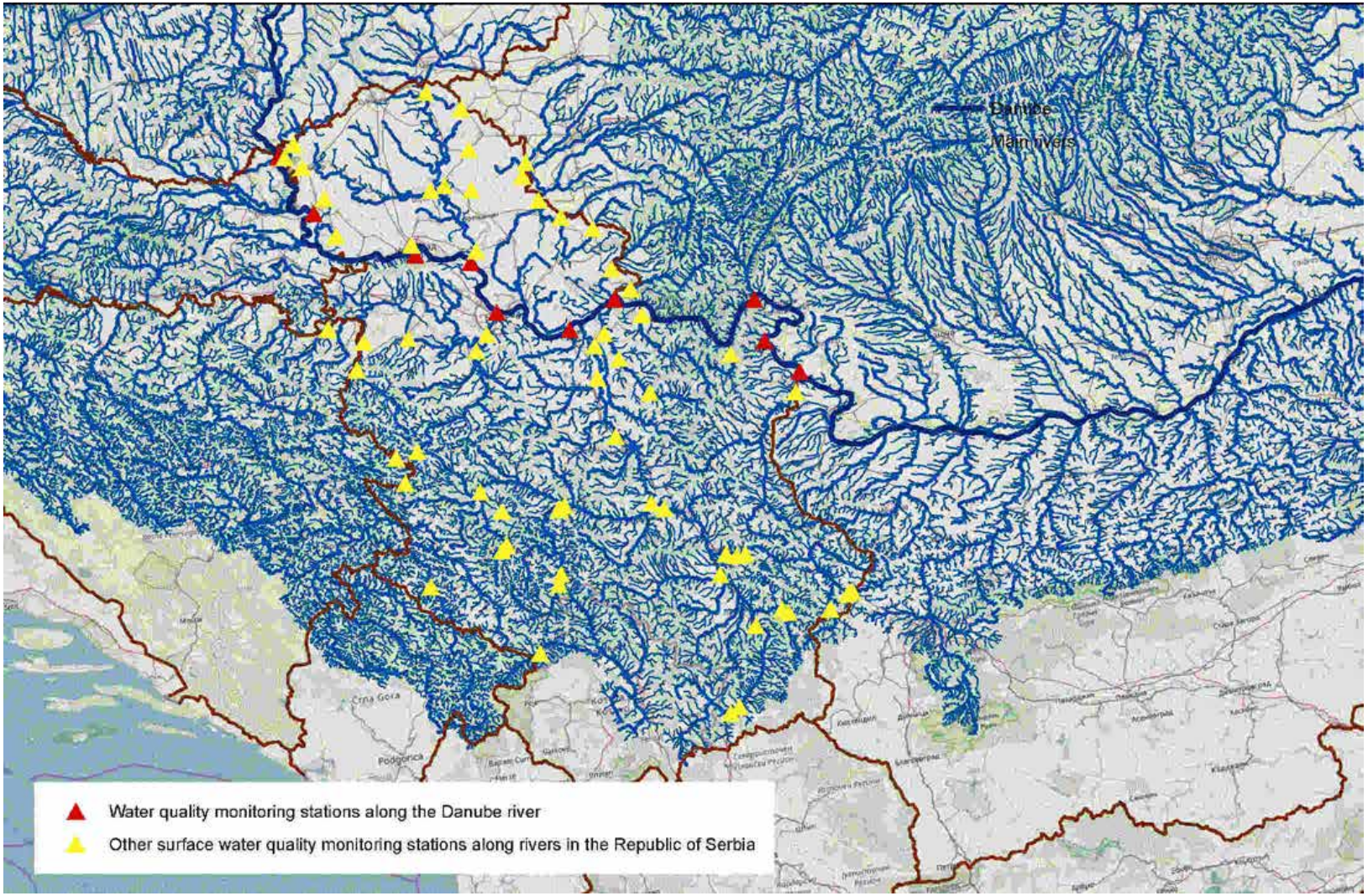


Fig.16 Monitoring stations on the Danube River and its tributaries in Serbia

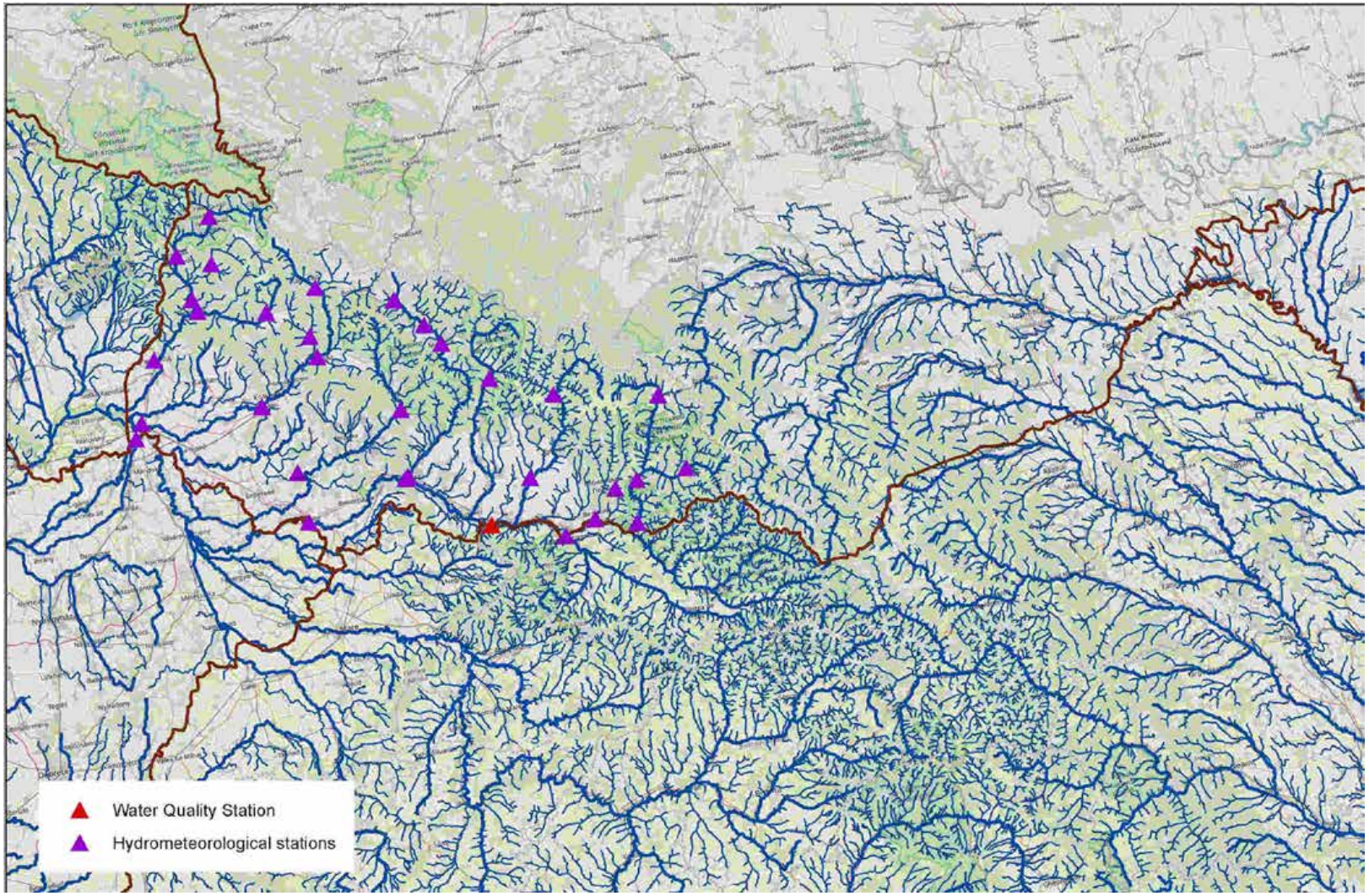


Fig.17 Monitoring stations on the Danube River tributaries in Ukraine

II.4. Polluters data availability

This chapter refers to the Data and metadata availability (including information on ambient or natural concentrations of HSs for establishing intervention measures) and to the list of past or current economic polluters referring to the direct effect on the quality of sediment in the Danube (the HSs whose possible concentrations are likely to be exceeded), information on the HSs biological effects, evidence of impact of anthropogenic activities.

Hungary: the polluters are known, but not listed. There is a lack of information about the contamination of overland flow and about the illegal sources.

Some other countries gave a link to the pollutants.

Austria: database of chemical analysis for water quality at:

https://wasser.umweltbundesamt.at/h2odb/fivestep/abfrageQdPublic.xhtml

Croatia: - register of major accidents at: http://iszz.azo.hr/rpot/nes.htm

Now this resource is not working and all needed information and raw data is located in Institute of Geology and Seismology.

It is supposed that increased concentrations of arsenic, lead, zinc, cadmium and ammonium are possible in the Croatian part of the Danube River Basin, due to their geogenic origin. In addition, anthropogenic contamination is possible due to big cities (Zagreb, Varaždin, Osijek, Slavonski brod) and industrial regions (NW Croatia, Slavonski brod, Sisak), as well as intense agriculture.

Republic of Moldavia: annual reports for the environmental status on the territory of Republic of Moldova are available from the site of State Hydrometeorological Service http://www.meteo.md/index.php/calitatea-mediului/c/

The River Basin Management Plan for the Danube-Prut and Black Sea pilot river basin district is available at:

https://www.euneighbours.eu/en/east/stay-informed/news/moldova-eu-supported-management-plan-danube-prut-and-black-sea-river-basin

The database of POPs polluted sites at: http://pops.mediu.gov.md.

Romania listed the main economic polluters, indicating also the polluting activities and the associated HSs.

In the Somes – Tisa basin, these polluters are listed for river, lakes, groundwater and air at:

https://www.eea.europa.eu/data-and-maps/data/waterbase-water-quality-1

https://www.eea.europa.eu/data-and-maps/data/waterbase-emissions-6

Serbia: http://www.sepa.gov.rs/index.php?menu=320&id=2015&akcija=showExternal

Slovakia: Within the monitoring of stream sediments in the programme of SGIDS, there are tables with data and metadata availability: basic localization of monitoring points, chemical composition, granulometric analysis and mineralogical analysis. In addition, there is a list of current economic polluters with direct effect on the Danube sediments.

Slovenia: Results of chemical analyses (water, sediment, biota) can be downloaded from the Slovenian water quality database via: http://www.arso.gov.si/vode/podatki/.

Sediment in the Drava river contains exceeded values of metals (values from 2016).

On the basis of these data (and of the list of big cities, legislation and literature data), which will be completed with relevant data by partner countries, the list of HSs for SIMONA project will be made.

II.5. Monitoring problems

Austria: monitoring is carried out in accordance with the WFD.

Croatia: did not implement sediment monitoring procedures, while water and biota monitoring are ongoing according to the guidelines of the WFD.

Procedures of monitoring in the past included the analysis of a smaller number of parameters and the sampling was done for more locations.

Hungary: Monitoring is carried out in accordance with the WFD.

Republic of Moldavia: The national monitoring program in Republic of Moldova is not working now on regular basis due to government reforming and lack of funding. There are several regional projects that can be a scientific support of the environmental monitoring in Republic of Moldavia.

Montenegro: The information on the state of environment with the Proposal of Measures is one of the basic documents in the field of environment and it is issued annually. The monitoring program is implemented by the institutions selected in the

tender procedure, according to State laws (Annex 10). The monitoring of the quality of air is implemented by D.O.O. "Center for Ecotoxicological Testing of Montenegro", while The Water Quality Monitoring Program is proposed by the Ministry of Agriculture and Rural Development and implemented by the Institute of Hydrometeorology and Seismology of Montenegro. The program for monitoring the quality of drinking water is carried out by the authority responsible for health affairs, in accordance with special regulations.

The Agency for the Protection of Nature and Environment implements a biodiversity monitoring program since 2013, entitled "Strengthening Capacity for Implementation of the Water Framework Directive in Montenegro.

Serbia: the implementation of the WFD requests a bigger number of parameters, which leads to additional costs. The country faces budget problems related to the analysis of so many parameters, therefore the sampling locations suffered a decline since 2011.

In conclusion, it is proposed in SIMONA that a special attention to be paid to a realistic approach in the selection of relevant HSs, which will be analyzed in order to establish sediment quality.

Slovenia: Monitoring is carried out in accordance with the WFD.

Ukraine: The monitoring of the current status of the Danube water basin in Ukraine along the Tisza River is carried out by the Basin Department of the water resources of the Tisza River.

http://buvrtysa.gov.ua/newsite/?page_id=107

In the framework of the former agreement between the Ministry of Water Management of the Ukrainian SSR and the State Agency of Water Resources of the Hungarian People's Republic on the topic "Information and measurement system for flood forecasting and water resources management in the river basins" (Budapest, 16.12.1986), in 2000, the creation of an automated information and measurement system for forecasting floods and water resources management in the Tisza River Basin (AIVS-Tisza) was launched.

With assistance from the Government of Hungary, eight hydrological stations in the Tisza basin were built and put into operation in the Transcarpathian region.

III. INVENTORY OF SAMPLING METHODOLOGIES

This chapter describes the characteristics aspects regarding sampling methodologies for water, sediments and biota.

III.1. Water

In all countries the decisions for sampling strategies are in accordance with the Annual monitoring program, the EU WFD Directive, the Regulations on limit values of polluting substances in surface and groundwater (listed in chapter 2.I.1). Institutions, monitoring authorities are listed in Table 1. Additionally, each country has experience with sampling within projects, highlighted in Chapter 2.II.1.

III.1.1. Design of sampling strategy

This question referred to information about: choosing sampling locations, number of sites, sampling position within the national Danube sector, distance from confluence points, distance from industry/agriculture point sources, distance from big cities, sampling depth, distance from the water course/bodies banks, temporal frequency of collecting samples.

A detailed description of the sampling design strategy is found for Slovenia in Annex 14.

III.1.2. Parameters of water quality/quantity measured in situ

In-situ measured parameters of water quality/quantity listed in the questionnaires are similar for all the project countries and all the measurement methods are standardized and listed (Annexes 2-15). A summary is presented in Table 32.

Table 32 – In situ analysis of water parameters

Type of in –situ analysis	Type of in –situ analysis	Type of in –situ analysis
Water temperature (0-40) ºC	Sulphate mgSO_4^{2-}/l (spectrophotometric)	organoleptic determination of the color of the water, which is defined as "visible color" and "intensity of visible color"

		according to Austrian standard ÖNORM M 6620
Water transparency (Secchi disk)> 10 cm	Ortophosphate (spectrophotometric) mgPO_4^{3-}/l	description of observations in the field with parameters of appearance, visible sewage, and the intensity of the odor.
Total and composite alkalinity (titrimetric) mg/l	Potassium permanganate consumption (Kubel- Teman titrimetric) mg/l	oxygen content
pH	Turbidity (nephelometric method) NTU	redox potential
Electrolytic conductivity µS/cm	Nitrate nitrogen (spectrophotometric) mgN-$N0_3$/l	Nitrite nitrogen (spectrophotometric) mgN- $N0_2$/l
Ammonium nitrogen (spectrophotometric) mgN- NH_3/l		

Almost all field measurements are made according to the appropriate analytical ISO or national standards that are listed in the questionnaire. For some of in–situ parameters, the following analytical standards are used by project partners (e.g. Austria, Annex 2):

- Water Temperature: standard SIST DIN 38404-4:2000, German Standard Methods for Analysing of Water, Waste Water and Sludge; Physical and Physical-chemical Parameters (Group C); Determination of Temperature (C4).
- pH value: standard SIST EN ISO 10523:2012, Water quality – Determination of pH.
- Electrical conductivity: standard EN 27888:1993, Water quality - Method for the determination of electrical conductivity.
- Oxygen: standard ISO 17289:2014, Water quality - Determination of dissolved oxygen – Optical sensor method.
- Turbidity: standard ISO 7027-1: 2016, Water quality – Determination of turbidity – Part 1: Quantitative methods.
- Redox potential: standard DIN 38404-6:1984 German Standard Methods For The Examination Of Water, Waste Water And Sludge; Physical And Physico-Chemical Parameters (Group C); Determination Of The Oxidation Reduction (Redox) Potential (C 6).

Other field measurements are done in accordance with the methods defined in each Instrument Procedures manual (e.g. DR 2800 Spectrophotometer – Serbia, Annex 12). Generally the indicated analysis procedures are based on international analytical standards or issued by the equipment producer.

III.1.3. Instruments for in situ measurements

For in situ measurements, the countries reported the following instruments:

- AUSTRIA - electrical conductivity, water temperature: WTW Type 3320 with sensor Tetra Con 325;pH: Type 3320 with sensor SenTix 41 (WTW) oxygen content: Type Multi 3630 IDS with sensor FDO® 925 (WTW) redox potential: Type pH 330 with sensor SenTix ORP (WTW) discharge: WTW Type 3320 with sensor Tetra Con 325; MRS-4 Trace (Sommer) Universal Current Meter F1 (SEBA) Starflow Model 6526 (Unidata).
- CROATIA - Hach (portable oxigen meter).
- SLOVENIA - WTW MULTI 3430, WTW MULTI 3420, WTW MULTI 197i, pH meter-WTW pH 315i, conduction meter-WTW Cond. 315i, turbidimeter, WTW TURB 430.
- SERBIA - Portable Spectrophotometer Instrument DR/2800, Hach for Ammonium nitrogen, nitrite nitrogen, nitrate nitrogen, sulphates and orthophosphate concentrations.

III.1.4. Methodology for in situ measurements

The questionnaires contain complete information about European and national analytical standards on the measurement method. In addition, some procedures are described in detail in some questionnaires (e.g. determining water transparency using Secchi disk in Serbia – Annex 12).

III.1.5. Tools for collecting samples for laboratory measurements

The answers are similar for the majority of the countries: telescopic sampling pole, with an adjustable holder for different sample containers and bottles.

III.1.6. Sample preservation

In situ conservation depends on the type of analysis to be performed in the laboratory. The preservation methods are also standardized.
Preservation recipes usually used for metals analysis: mL of HCl (1:1) in 1L sample volume.
Samples chemical preservation according to their type and used analysis method: 2mL of conc. H_2SO_4 in 500 mL sample volume for PI, TN, and TP analysis, where:

TP - Application of inductively coupled plasma mass spectrometry (ICP-MS)

TN - Determination of nitrogen — Determination of bound nitrogen (TNb), following oxidation to nitrogen oxides
PI - Determination of permanganate index.

III.1.7. Methodology for sample collecting

Surface water should be sampled in accordance with international standard “SIST ISO 5667-6: 2015 Part 6: Guidance on sampling of rivers and streams”. Samples of surface water are taken at a depth of 0.5 m, as close as possible to the centre of the surface water. For waters shallower than 1 m deep, the samples are taken at half the depth. In lakes, reservoirs, and the sea, samples are taken with an integral sampler throughout the vertical profile.

During the project „Geochemical Atlas of Europe. Part 1 - Background Information, Methodology and Maps“, a precise and detailed water sampling strategy was established by some partners (e.g. Hungary, Slovakia) and the FOREGS Geochemical Mapping Field Manual was created for stream sediments and floodplain sediments (http://weppi.gtk.fi/publ/foregsatlas/index.php).

A very detailed description according to the Geochemical Mapping Field Manual is found in the Slovakia questionnaire (Annex 13).

Conclusions:
Related to III.1.4-III.1.7, it can be said that water sampling, samples transport and samples conservation are standardized by EN ISO 5667 in all partner countries and are conform to the following EU documents:

- EU WFD Guidance Documents (http://ec.europa.eu/environment/water/water-framework/facts_figures/guidance_docs_en.htm)
- Directive 2000/60/EC (https://eur-lex.europa.eu/resource.html?uri=cellar:5c835afb-2ec6-4577-bdf8-756d3d694eeb.0004.02/DOC_1&format=PDF)
- Directive 2014/101/EU (http://extwprlegs1.fao.org/docs/pdf/eur140065.pdf)

III.2. Sediments

III.2.1. Type of sampled/measured sediment

All countries have experience with sediment sampling in the framework of scientific research projects according to chapter 2.II.1 and 2.III.2. In some countries the authorities monitor sediments. Tables 25, 26 and 27 show this information.

III.2.2. Design of sampling strategy

For all partner countries, the sampling design, frequency and sampling locations are determined in accordance with the requirements defined in the “Guidance on the design of sampling programmes and sampling techniques” (ISO 5667-1:2006), as well as in the periodical (annual) monitoring programmes defined by competent ministries (Ministries of agriculture, forestry and water management, Environmental Protection Agencies etc.).
The sediments are monitored every 3 years (according to the Directive 2008/105/UE). For the countries where sediment monitoring is not performed, the selection of the sample locations is made according to the objectives of the research projects and the design of the sampling strategy according to ISO 5667.

In Slovakia, the *Geochemical Mapping Programme* (in SGIDS), notably at large regional scales, requires the selection of an optimum geological material to be sampled. The sampled material should not only have suitable geochemical properties, but should be also available more or less throughout the mapped area. Another very important fact that should be borne in mind is that the same sampling procedures must be used throughout the sampling campaign, and all over the sampled area. Each collected sample is stored in a separate polyethylene bag. Where it is possible, 1.2 kg of the finest clay material were collected from at least three points over a distance of about 20 m along the stream.
The Water Research Institute in Slovakia uses for bottom sediments sampling the UWITEC Core tube sampler (and its components) working on the gravity principle, with a telescopic rod and the possibility of driving straight into the sediment.

In Ukraine, in order to assess anthropic pollution during ecological and geochemical studies of bottom sediments, water flow sites with oozy sediments are selected, which in most cases (if there are man-made sources of water flow contamination) correspond to the so-called "man-made" sediments (oozy fraction <0.1 mm, fully

concentrating the chemical pollution elements). For sampling of bottom sediments in the watercourse, the selected locations are those in which sludge is accumulated (entrance to bays, places behind the banks with backflow, etc.). Sampling takes place once a year, in the summer time, during the period of lowest water (Annex 15).

III.2.3. Parameters of sediment quality/quantity measured in situ

Only Austria answered this question, the in situ measured parameters being: electrical conductivity, pH, redox potential (in water-saturated sediments).
In Romania the quantity of collected sediment depends on the texture, but no parameters are measured in situ.

III.2.4. Sampling devices for in situ measurements

In some questionnaires there are listed: shovel (made of wood or stainless steel), drills for manual drilling or Scissor grab (of stainless steel), such as Van Veen grab sampler/Graifer/ Core sampler, PVC spoons. The sediment is stored in a glass (650 mL).
A detailed description of the sampling technique is made in the part of the Romanian questionnaire completed by RO-TUC (Annex 11):

- for sediments in suspension, it is used the rapid collector Nansen bottle (cylinders with flaps for sediments).
- for dragged sediments the frequently used devices consist in: trap Nansen bottle (ISCH type) and sieve Nansen bottle.
- for river bed sediments, the under water sampling is done with GRAIFER, CAROTIER, and from the floodplain (dry sampling) with an ordinary shovel.

More explanations regarding the collecting procedure are found in the above mentioned Annex 11.

III.2.5. Methodology for in situ measurements

In Austria in situ measurements are done with multi-parameter portable devices. The instruments are calibrated prior to the measurement campaign (and for pH every morning).

III.2.6. Tools for collecting samples for laboratory measurements

At this question, answers were received from several countries. Some use stainless steel shovels and sieves, according to DIN 4188 (Austria, Annex 2).

Various devices are used in the Republic of Moldavia (Annex 10): Ekman dredge for soft sediments on deeper water sites, simple cylinders for soft and thin sediments (10 – 30 cm), Auger sampler for thicker sediments.
In Ukraine (Annex 15) a plastic scoop, or a stainless steel blade is used for 0.2 - 0.3 m thick silt and sandy sediments. For 0.3 - 3.0 m thick mud, the Giller peat drill is used.

III.2.7. Methodology of sample collecting for laboratory measurements

To this question, there are detailed answers in many questionnaires. Information refer to similar procedures according to ISO standards.
Generally, as the questionnaire of Slovenia (Annex 14) shows: "the sediment sample is wet sieved through sieves (made of inert plastics) with a size of 200 µm and then of 63 µm. The fraction with a grain size below 63 µm is used for chemical analysis. Water from the same surface water was used for sieving."
In the case of preparation of the sample for further analysis, as Croatia shows (Annex 7): "sampling is conducted according to the parameters intended to be analyzed later":
a) sampling for polar parameters (pesticides, pharmaceuticals, hormones, personal care products etc.) is conducted only after the water has withdrawn to watercourse and as close as possible to the point where the water flow before the withdrawal was minimal. The sediment sample is grabbed with the clean plastic spatula/spoon (inert plastics), to the depth of maximum 2 cm. The sample is stored in a dark glass bottle.
b) sampling for all other parameters is conducted from the watercourse, using polyethylene spoon. The sample is taken from the sediment surface or up to 1 cm deep. The samples should be composite, taken from three different points within a perimeter of 2 m. The sample is stored in a glass or plastic bottle, overflown with water from the sampling location before sealing the bottle.
Sample homogenization is conducted by mixing and, for some samples, by sieving.
According to Ukraine (Annex 15): an average sample of not less than 0.5 kg is put in a white cloth bag marked with a label. The sample will be dried in a well ventilated room (under a canopy) at ambient temperature and swept through during drying. After drying, the sample is sieved through a nylon sieve with a diameter of 1 mm, divided in four parts (for laboratory samples and a duplicate). For sample identification in the laboratory, the neccesary data are written on the paper bags. The duplicate samples are stored in a kraft paper bag or polyethylene container (with the appropriate markings, too), placed in a dry, cool room.

Figure 16 below shows the sample preparation scheme used by IGR for various analyses of the Danube and Danube Delta sediments (Annex 11).

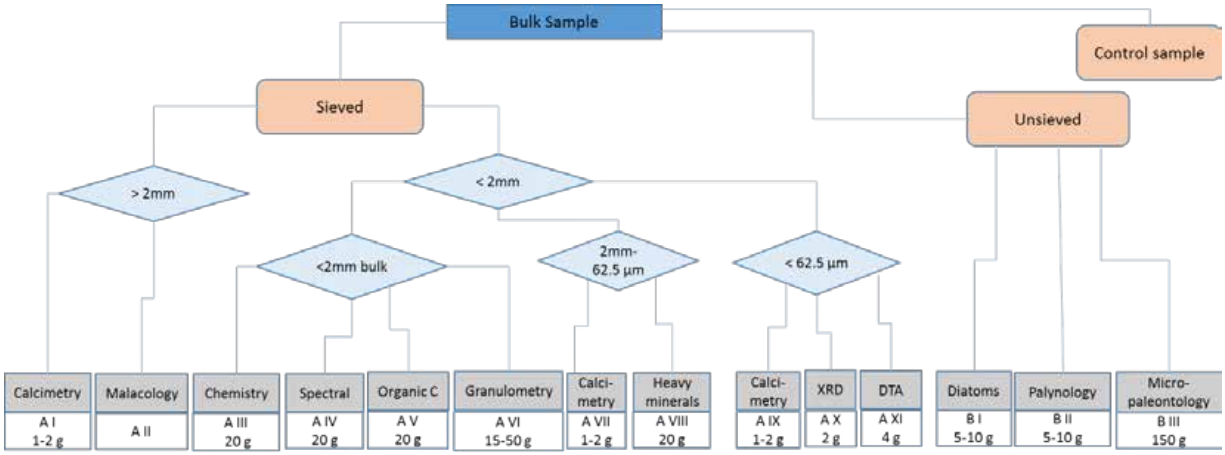


Fig 18. Sample preparation scheme for various analyses of the Danube and Danube Delta sediments

According to the Romanian partner (TUCN), for the tributaries in the Somes – Tisa catchment, sampling is done as follows: the collected sample (with the probe or shovel) is poured on a tray; the water is drained from the tray and the sample is spread on a piece of cloth to drain all the water; the sample is very well mixed, then it is spread in a layer of the same thickness; one part (one quarter, one half etc.) is taken from the global sample, depending on the size of the sample and the granules. The weight of the global sample depends on the maximum diameter of the deposited sediments, namely:

• when the maximum diameter is greater than 7 cm (boulders), the weight of the aggregate sample should be about 10 kg;

• if the maximum sediment diameter is between 3 and 7 cm (gravel), the weight of the aggregate sample will be 3 - 5 kg;

• if the maximum diameter of gravel is between 1 and 3 cm, the weight of the bulk sample will be about 1 kg;

• for a maximum diameter of less than 1 cm, the average sample will be several hundred grams.

The average sample is placed in a strong cloth bag.

The following data shall be filled in on a sheet of paper: the river, hydrometric station, the collecting date, the weight and the diameter of each boulder larger than 8 - 10 cm that was part of the average sample, but no longer inserted into the bag.

III.2.8. Transport methodology of samples for laboratory measurements

Transport of the samples is done with cooling at 2°C - 8°C. If it is intended to store the samples for longer periods (more than a month), it is recommended to freeze the samples at -20°C.

For points III.2.2 – III.2.8, a very detailed description is offered by Slovakia questionnaire (Annex 13), according to Geochemical Mapping Field Manual (Stream sediments) and Reservoir Sampling (Water Research Institute WRI – VÚVH).
Related to III.2.5 – III.2.8, the conclusion is that sediment sampling, sample transport and sample conservation are standardized by EN ISO 5667- Part 15*: Guidance on the preservation and handling of sludge and sediment samples*.

III.2.9. Sample archiving

At this question, the answers are centralized in Table 33.
A rich experience exists in all countries. A national monitoring according to a procedure guide exists only in few countries.

III.3. Biota

III.3.1. Type of biota

In Slovenia (Annex14) inland waters are sampled for fauna (fish, crustaceans and molluscs) according to the Decree on the status of surface waters. Priority species for the determination of HSs in inland waters are *Salmo marmoratus* and *Brown Trout.*
The selection of biota is in agreement with the dangerous substance that are accumulated. A detailed enumeration in this regard is shown for Romania (Annex 11).
A series of algae, bryophytes, amphibian or hydrophylic organisms have strong concentration of both mineral elements (heavy metals) and organic xenobiotic compounds in the tissues.
Aquatic muscles with potential for bioaccumulation are among others: *Fontinalis*, *Amblystegium*, *Rhychostegium*, *Plathyhypnidium*, *and Cindidotus*.
A number of studies have established that *Fontinalis squamosa* and *Fontinalis antipyretics* have a high capacity of bioaccumulating Zn and other toxic metals. It was found that the last species also accumulates PCBs or other xenobiotic organic compounds, or rare metals (very low concentrations) like Ag, Bi, and Sn.

Algae. Red alga *Lemanea sp.* is one of the few macrophytes that can live in the immediate vicinity of water from tailings ponds of Pb exploitation. It can develop in waters with high concentrations of toxic metals and can be found in waters containing 1.16 mg/l Zn.

Phanerogams. *Typha latifolia* has proven to be an effective Zn bioaccumulator, accumulating in the roots up to 1400 mg Zn/kg when the plants have grown on sediments containing 10 mg Zn/kg of sediment.

Molluscs and other aquatic invertebrates. *Lamelibranhi* molluscs are excellent bio-indicators for contamination of both continental and marine waters. They have considerable bioaccumulation capacities and additionally, they are sedentary, which is very useful in detecting and locating more precisely the source of contamination.

In freshwaters, large bivalves such as *Unio*, *Anodonta* (river clam), *Dreissenia* are of particular interest because of their relatively high frequency. To these there are added some small bivalves of the sweet medium such as spheroids: *Sphaerium*, *Pisidium*.

Fish. Fish species at the top of the organic pyramid, with a rapier or superior kidnapper regime, are likely to have concentration factors 10 times greater than the water content of certain mineral or organic contaminants.

The fish have been widely used as bio-indicators for the pollution of aquatic ecosystems with heavy metals or with other toxic elements. Thus, the study of copper bioaccumulation in rainbow trout (*Salmo gairdneri*) demonstrated a very good correlation between the concentration of Cu in the body of the fish and the water content. The *Esox lucius* has proved to be an excellent bioindicator for monitoring the pollution of mercury-containing ecosystems. In this case, a very good correlation between the “pike” Hg content in the fish body and the Hg content in the sediments was established. Its bioconcentration capacity also depends on the pH of the water, being higher in acid waters.

III.3.2. Design of sampling strategy

In Slovenia (Annex 14), the period for the collection of fish samples is July, August, September, the period for the sampling of crustaceans and molluscs being not specified.

In Montenegro (Annex 10), the material is collected from March to November (all seasonal aspects).

III.3.3. Parameters of biota quality/quantity measured in situ

In Slovenia (Annex 14) and Croatia (Annex 7), during sampling, collected fish is visually inspected and counted; species and age are also determined and fish is selected accordingly. The length and weight of fish are measured.
In Montenegro (Annex 10) the qualitative composition of the organism is registered on site.
In Hungary (Annex 8) additional data are recorded: habitat type (small, medium, large, very large river basin, Danube), other sampling conditions (e.g. what kind of modifications were required in the sampling procedure due to field conditions), the value of some abiotic variables characteristic of the sampling phase (average water depth at the sampling stage, average water depth at the sampling site, average flow rate, substrate composition, full coverage of the bottom cover and its composition in %, composition of coastal vegetation and structure of the river bank).

III.3.4. Instruments for in situ measurements

Generally there are no answers for this question, except for Croatia (Annex 7), where the biota is visually inspected. In Slovenia (Annex 14), the weighting device is used.

III.3.5. Methodology for in situ measurements

According to Slovenia questionnaire (Annex 14) the age analysis of the fish must be done prior to the analysis of hazardous substances. To identify hazardous substances in inland waters, 9 specimens of the same species should be taken, or the total weight of fish should exceed 900 g (or 5 specimens with a total weight of more than 500 g). The weight of each specimen must exceed 100 g, and the length must correspond to the prescribed lengths.
The specimens must not be touched with hands, the use of protective gloves is necessary. Also, metal contamination must be prevented in a way that any contact with metal objects is prevented.
“With non-metallic supplies, a specimen of up to 20 scales is used to determine the age” - Annex 11. Each removed specimen shall be appropriately marked to enable traceability. If necessary, after each sampling, all the equipment used is disinfected or discarded.
Crustaceans and molluscs:
Recommended mass of the specimen is > 5 g and the number of specimens is > 170. Approximately 170 adult specimens with a total weight of more than 5 g should be taken to identify hazardous substances. The specimens must not be touched with

hands, the use of protective gloves is necessary. Also, metal contamination must be prevented in a way that any contact with metal objects is prevented.
Adult specimens with an approximate size of 9 mm or more and an approximate weight of 30 mg or more shall be collected. The composite sample is weighed to precisely 0.1 g. If necessary, after each sampling, all the equipment used is disinfected or discarded.
The shells are sampled manually and stored in polythene bags.
Data on species (abundance) established in the field are recorded in field records.

III.3.6. Tools for collecting samples for laboratory measurements

In Bosnia and Herzegovina – Republic of Srpska (Annex 4) there are used:

- Plankton net, EFE and GB nets, made from Monodur Nytal with pores of 20 µm.
- Collecting algae and other suspended mattter by filtration (ISO 10 260:2002).
- Phytobenthic organisms (BAS EN 13946:2003).
- Benthic invertebrate by hand net with 250 µm pores, Ekman-Birge sediment sampler and dredge depending on the substrate, river bed morphology, depth and velocity of stream.

Electrical methods for collecting fish are used in Slovenia (Annex 14) and Croatia (Annex 7). Fish samples are collected using direct current electro-aggregates, with at least 2.5 kW (for fishing from the shore) and at least 5 kW (for fishing from the boat). Aggregates have to allow the use of pulse current. For fishing in big rivers aggregates with 7.5 kW and 11 kW were used. For the invertebrates: shellfish are collected by hand and Gammaridae were sampled using Surber net.
In Montenegro (Annex 10), planktonic and "homemade" networks are used for collecting biota samples.

III.3.7. Methodology of sample collecting for laboratory measurements

In Croatia (Annex 7) the fish are handled with gloves, to protect from contamination. After sampling, the fish should be frozen at -20ºC. Prior to analysis, muscle tissue for analysis have to be removed while fish is half-thawed and then homogenized. The whole fish is used also for the analysis of some parameters. After homogenization and lyophilization, samples are stored at -20ºC.
For the invertebrates: The collected organisms should be immediately frozen at -20ºC. The whole organism (soft tissue) is used for analysis. After homogenization and lyophilization, the samples are stored at -20ºC.

In Montenegro (Annex 10) a sample taken from the field is made of a membrane and poured into a Petri cup, then observed under the binoculars and detailed notes are recorded of the species. For some species it is necessary to separate them on the subject glass and examine with a microscope.

III.3.8. Transport methodology of samples for laboratory measurements

Biota samples are kept on ice and in the laboratory they are frozen at -20ºC.
In Montenegro (Annex 10) the material taken in the field is placed in bottles (of different shapes and sizes) and fixed with a solution of 4% formalin.

III.3.9. Sample archiving

Monitoring of biota for the evaluation of chemical status of surface water bodies is done according to the Common Implementation Strategy for the Water Framework Directive (2000/60/EC) and ISO 5667. The sampling methods are described too in the APHA and OECD guides and documents.

III.4. GENERAL CONCLUSIONS

For water, soil, sediments and biota samples the protocols for sampling, transport and storage are conform to the following ISO documents:

Table 33 - Protocols for sampling, transport and storage used for sediments, soil, water and biota.

Procedure	Sediment	Soil	Water	Biota
SAMPLING - procedures to locate points from which samples may be taken for examination - recomandated instruments that may be installed for in situ measurement including statistical implications - methods of collecting samples - procedures for determining quantities, number of samples -freqvency of sampling - what laboratory samples are to be taken, how they are to be taken and from	ISO 5667-1:2008. Water quality - Sampling - Part 1: Guidance on the design of sampling programmes and sampling techniques for all aspects of sampling of water (including waste waters, sludges, effluents and bottom deposits). ISO 5667-17:2012. Water quality. Sampling. Part 17: Guidance on sampling banks and suspended material ISO 5667 Part 12: Bottom sediments. Water quality -- Sampling -- Part 13:2011 Guidance on sampling of sludges	ISO 10381-1:2002. Soil quality -- Sampling -- Part 1: Guidance on the design of sampling programmes Part2:Guidance on sampling techniques) (has been revised by ISO18400-101:2017; ISO 18400-104:2018; ISO18400-107:2017) ISO 18400-100:2017. Soil quality -- Sampling -- Part 100: Guidance on the selection of sampling standards https://www.iso.org/standard/67788.html ISO 18400-101:2017Soil quality -- Sampling -- Part	ISO 5667-1:2018. Guidance on the design of sampling programmes and sampling techniques ISO5667-6:2014. Guidance on sampling of rivers and streams ISO 5667-11:2009. Water quality — Sampling — Part 11: Guidance on sampling of groundwaters. https://www.iso.org/standard/42990.html Part4: Lakes and water reservoirs Part5: Drinking water Part8: Rainfall Part10: Waste Part 15: Natural waters	ISO 5667-16:2017. Water quality. Sampling. Part 16: Guidance for biological analysis Water Framework Directive (2000/60/EC) Guidance document No.32 on biota monitoring HRN EN 13946:2015 (Guidance standard for the routine sampling and pretreatment of benthic diatoms from rivers and lakes) HRN EN 15708:2010 (Advisory norm for testing, sampling and laboratory

where they are to be taken, in order that the objectives of the investigation programme can be achieved		101: Framework for the preparation and application of a sampling plan https://www.iso.org/standard/62842.html ISO 18400-102:2017. Soil quality -- Sampling -- Part 102: Selection and application of sampling techniques. https://www.iso.org/standard/62843.html ISO 18400-103:2017. Soil quality -- Sampling -- Part 103: Safety https://www.iso.org/standard/62363.html ISO 18400-104:2018. Soil quality -- Sampling -- Part 104: Strategies https://www.iso.org/standard/65223.html ISO 18400-202:2018 Soil quality -- Sampling -- Part 202: Preliminary investigations	ISO 5667-23:2011. Water quality -- Sampling -- Part 23: Guidance on passive sampling in surface waters https://www.iso.org/standard/50679.html	analysis of phytobenthos in shallow streams

		https://www.iso.org/standard/65225.html ISO 18400-203:2018. Soil quality -- Sampling -- Part 203: Investigation of potentially contaminated sites https://www.iso.org/standard/65226.html EPA/625/12-91/002 EPA/600/R-92/128 -Alaska Department of Environmental Conservation, 2009, Draft Guidance on MULTI INCREMENT Soil Sampling, Division of Spill Preventions and Response, Contaminated Sites Program, www.itrcweb.org/ism-1/references/multi_increment.pdf		
SAMPLING Recording and reporting, correlating, decision making		ISO 18400-107:2017.Soil quality -- Sampling -- Part 107: Recording and reporting	Water quality -- Sampling -- Part 14::2014 Guidance on quality assurance and quality control of	SRPS EN 27828:2009Water quality - Methods of biological sampling - Guidance on handnet sampling of aquatic

		https://www.iso.org/standard/62365.html ISO 28258:2013 Soil quality -- Digital exchange of soil-related data https://www.iso.org/standard/44595.html Now under development ISO 28258:2013/DAmd 1 https://www.iso.org/standard/72743.html ISO 15903:2002 Soil quality -- Format for recording soil and site information https://www.iso.org/standard/29028.html	environmental water sampling and handling	benthic macro-invertebrates
TRANSPORT AND STORAGE (methods for containing, storing and transporting samples to prevent deterioration or contamination)	ISO 5667-15:2013. Water quality - Sampling - Part 15: Guidance on the preservation and handling of sludge and sediment samples		Part 5667-15: Natural waters ISO5667-2018Water quality -- Sampling -- Part 3: Preservation and handling of water samples https://www.iso.org/standard/72370.htm	

Regarding the design of the sampling strategy for water, sediments and biota samples (III.1.1 - III.1.2; III.2.1 – III.2.2; III.3.1 - III.3.2), Table 34 contains the information provided by all partners.

Table 34 – Sampling strategies for water, sediment and biota

Country	SAMPLES			Observations
	WATER	SEDIMENT	BIOTA	
AT	Federal Environment Agency Austria (UBA)	**-bottom and floodplain** (Geological Survey of Austria) **-bottom, floodplain and suspended** (UBA) Sampling of stream sediments is standardized by the Austrian norm ÖNORM G 1031	The Environment Agency of Austria collects biota samples according to the GZÜV-monitoring network.	For water sampling, UBA follows a fixed design of location and number of sampling sites. Sampling frequency of water at risk is 4 times per year. Surface water sampling frequency is 1 time per month, additional sampling is carried out sporadically depending on governmental contract or running project. -Biota sampling according to the GZÜV-monitoring network
BA	Water sampling is executed by the ExEA	Sediment sampling is executed by the ExEA	Phytoplancton, phytobenthic, macrophytic, benthic invertebrate and ichtyofauna.	Water and sediment sampling strategy is defined by the River Basin Management Plan for the Danube Region (2016-2021)
BA-SRP	Sampling locations for trend analysis: upstream/downstream of the country border, near the confluence points of bigger streams,	There are no data on sediment.	Phytoplankton, phytobenthic, macrophytic, benthic invertebrate and ichtyofauna	Sampling locations for ecological and chemical status of certain water bodies and sampling locations for background concentrations are situated at specific locations, different from those for trend monitoring.

Country	SAMPLES			Observations
	WATER	SEDIMENT	BIOTA	
	downstream of larger contamination sources.			Priority substances are monitored in rivers and lakes every month. Other physico-chemical parameters are monitored every 3 months; Hydrology – continuously (respectively monthly), other hydromorphological features – every 6 years; fish, macroinvertebrates and flora - every 3 years; phytoplankton – every 6 months.
BG	Sampling strategy is defined by the River Basin Management Plan for the Danube Region (2016-2021) and is executed by the ExEA.	Sampling strategy is defined by the River Basin Management Plan for the Danube Region (2016-2021) and is executed by the ExEA.	БДС EN ISO 5667-16:2017 Water quality. Sampling. Part 16: Guidance for biological analysis	
HR	According to the methodology requested by Water Framework Directive (WFD).	Croatia does not monitor yet the sediments, but it monitors water and biota. Water and biota are investigated according to the methodology requested by WFD.	fish tissue, shellfish, gammaridae	Sampling biota (2017-2019) design is done in order to fulfill WFD requirements (2000/60/EC) (Guidance document No.32 on biota monitoring). During next three years, from 2019 onward, this methodology will be tested on 41 surveillance monitoring stations for all required parameters (chemical status). Frequency will be 1 per year. The same parameters are planned to be analyzed in the sediment on all those stations, as well. Poly-aromatic hydrocarbons are a specific

Country	SAMPLES			Observations
	WATER	SEDIMENT	BIOTA	
				test in the shellfish and gammaridae tissue, but sampling is difficult since they live in clean water and sandy bottom. Radionuclide monitoring in water, sediment and biota, at country level, is performed by Institute for Medical Research and Occupational Health, Zagreb.
HU	According to the methodology requested by Water Framework Directive (WFD).	Hungary does not accredited monitor yet the sediment. Hungary samples bottom sediments.	fish (mainly chub)	investigating monitoring program to find the best sampling sites for long-term biota and sediment monitoring
MD	Centre of Environmental Quality Monitoring (CEQM) of Hydro-meteorological Service of Republic of Moldova performs hydro-biological monitoring in Danube – Prut river basin by 6 groups of hydro-biologic indicators	All types of sediments	CEQM monitoring: bacterioplankton, phytohytoplankton, zooplankton, phitobentos,macrophytes.	Biota monitoring(Institute of Zoology) for scientific projects on territory of Republic of Moldova including Danube – Prut river basin. Institute of Geology and Seismology takes samples of plants, agriculture crops, fish, milk, eggs, and meat for the risk assessment of the pollution in scientific projects.
ME	Systematic testing of the quality of surface and groundwater in the territory of Montenegro is carried out in accordance with the Program on	Montenegro is not monitoring yet the sediments. Montenegro samples bottom sediments.	Agency for the Protection of Nature and Environment implements a biodiversity monitoring program since 2013.	There is a lot of experience across within projects. The locations of the biota monitoring program are different each year.

Country	SAMPLES			Observations
	WATER	SEDIMENT	BIOTA	
	Systematic Testing of Quantities and Water Quality in Montenegro, which is adopted by the competent Ministry of Water Management, Forestry and Agriculture. The program defines a network of stations for water quality, as well as the scope, type and frequency of water quality tests. In situ measured parameters: temperature, pH value, electrolytic conductivity, turbidity and alcalinity.		*Turbellaria, Hirudinae, Oligochaeta, crabs (Cladocera, Copepoda, Decapoda) and insects (Odonata, Placoptera, Trichoptera, Ephemeroptera, Diptera).*	Selecting the biota sampling location: sites of national importance, protected areas and NATURA 2000 habitats.
RO	National Organization of Romanian Waters (According to the methodology requested by Water Framework Directive)	Sediments in suspension, dragged sediments, river bed sediments (experience within projects)	National Organization of Romanian Waters (plankton, bacteria, periphyton, protozoa, algae, fungi, macrophytes, macro invertebrates, bivalves and fish)	The design of biota sampling is done in order to fulfill WFD requirements (2000/60/EC) and to establish water quality. Biota is selected in agreement with the dangerous substances that might be accumulated in the living organisms.

Country	SAMPLES			Observations
	WATER	SEDIMENT	BIOTA	
			The biological elements which form the basis of the assessment of the ecological status of the Danube and major rivers will be taken into consideration according to the following ranking: 1. phytoplankton; 2. phytobenthos; 3. macrozoobenthos; 4. macrophytes / angiosperms; 5. fish	The ecological status of continental aquatic ecosystems must be established on the basis of biological quality elements, taking into account the hydromorphological, chemical, physico-chemical, and specific pollutants indicators that influence biological indicators. The assessment of these elements may indicate the presence of natural conditions, their minor alterations or the magnitude of the anthropic impact and, respectively, the state of water body quality over a certain period of time. For artificial or irreversible modified aquatic ecosystems, the ecological potential is established as: very good (E), good (B), or moderate (M).
SK	Methodology developed within the project „Geochemical Atlas of Europe. Part 1 - Background Information, Methodology and Maps“. In situ measured parameters: temperature (water, air), pH, Eh, Ec, O2	There is the Geochemical Mapping Programme (SGIDS) for Stream sediments. The Water Research Institute WRI – VÚVH)Tperforms the Reservoir SEDIMENT SAMPLING.		A precised and detailed sampling strategy for water and sediments was established in FOREGS GEOCHEMICAL MAPPING FIELD MANUAL. http://weppi.gtk.fi/publ/foregsatlas/index.php

Country	SAMPLES			Observations
	WATER	SEDIMENT	BIOTA	
SI	The program for monitoring the status of waters for the period 2016 - 2021 (Water Management Plan) has been prepared in accordance with national and European legislation. Slovenia is involved in the Transnational Monitoring Network (TNMN) on the Danube tributaries, on the Sava and the Drava Rivers.	Bottom sediments. For the general chemical status in Slovenia, sediments are monitored at most surveillance measuring points; In addition, they are also monitored at sites where pollution loads are detected (eg PCBs in Krupa, Lahinja, Kolpa). No parameters are measured in situ.	Fish (priority species *Salmo marmoratus* and *Brown Trout*.) crustaceans and mollusc s In inland waters. The TNMN biological monitoring program is adapted to the requirements of the Water Framework Directive (Directive 2000/60 / EC).	Sediments are monitored for trends every 3 years, in accordance with Directive 2008/105/EU, Decree on the status of surface waters and the Rules on the monitoring of surface waters.
SR	Sampling is done in accordance with the Annual monitoring program, as well as the Regulation on limit values of polluting substances in surface and groundwaters and deadlines for their achievement. In situ measured parameters include: water trasnparency, alkalinity, pH, Ec, turbidity, and	Bottom sediment (The Serbian Environmental protection Agency)	Biota is not monitored by the Serbian Environmental Protection Agency within it's Danube river monitoring program.	The design of sampling, frequency and sampling locations are determined in accordance with the requirements defined in the Guidance on the design of sampling programmes and sampling techniques (ISO 5667-1:2008), as well as the annual monitoring program defined by the Ministry of agriculture, forestry and water management. Responsible institution for radionuclide monitoring in the environment, is the National Directorate for Radiation and Nuclear Safety and Security. http://monradrs.srbatom.gov.rs/

Country	SAMPLES			Observations
	WATER	SEDIMENT	BIOTA	
	presence of certain compounds.			The Annual Monitoring program does not include the monitoring of specific radionucleides but rather total beta radioactivity is monitored. However, radionucleide concentrations are monitored through projects and specific requests.
UA	Sampling planning is carried out according to DSTU ISO 5667-1: 2003, DSTU ISO 5667-2: 2003, DSTU ISO 5667-3: 2001, DSTU ISO 5667-4: 2003, DSTU ISO 5667-6: 2001. No in situ parameters are measured.	Bottom sediments. Sampling locations are selected according to DSTU ISO 5667-12-2001.	No biota sampling.	For sampling of bottom sediments in the watercourse, places are selected in which sludge deposits are accumulated (entrance to bays, places behind the banks with backflow, etc.). Sampling takes place during the summer low water period once a year.

IV. INVENTORY OF LABORATORY METHODOLOGIES

IV.1. Mechanical preparation of samples

Inventory techniques and procedures are similar in partner countries and consist of:
-for sediment sample: drying, sieving, grinding, homogenization (e.g. in Slovakia - Fig. 19)
Generally sediment sample preparation is done according to standard methods involving crushing, grinding, wet sieving (disk mill - grain size <60 µm) for metal analysis; chemical drying with sodium sulphate (water-free) and grinding for organic substances.

- in-situ sieving to <180µm and <40µm grain size (two samples per site)
- drying of sample at ambient temperature (<30°C) until water content <2 mass %
- crushing of components which agglomerated during drying using porcelain mortar

-for water samples: filtration (0.45 µm)
-for biota samples: homogenization, cryogen grinding

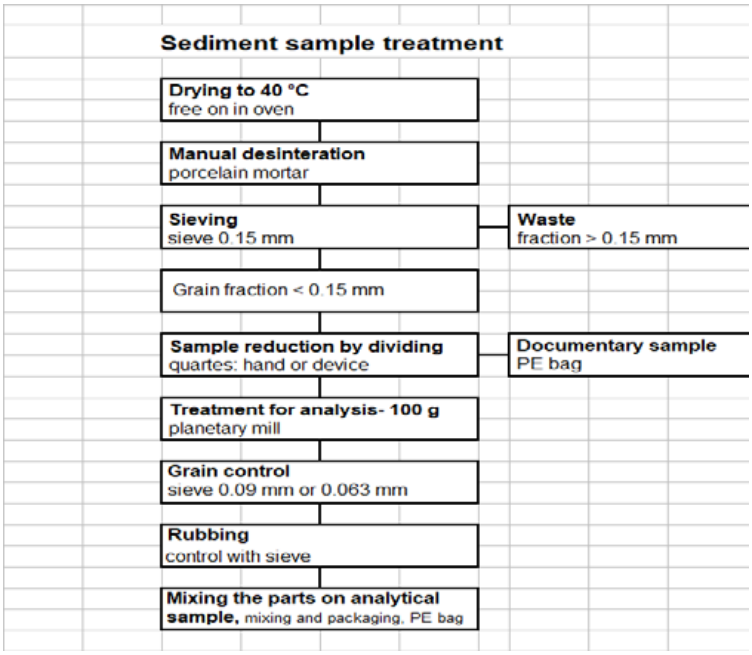


Fig. 19 Procedure for sediment samples preparation in Slovakia

For soil samples the following schema (Fig. 20) according to the questionnaire in Slovakia (Annex 13) describes a complete procedure. According to ISO11277:2009, determination of particle size distribution in mineral soil material is possible.
For the mechanical preparation of biota samples there are few information in the questionnaire. Slovenia (Annex 14) presents detailed procedures for laboratory treatment of fish, crustaceans and molluscs, according to EN14996:2006 standard.

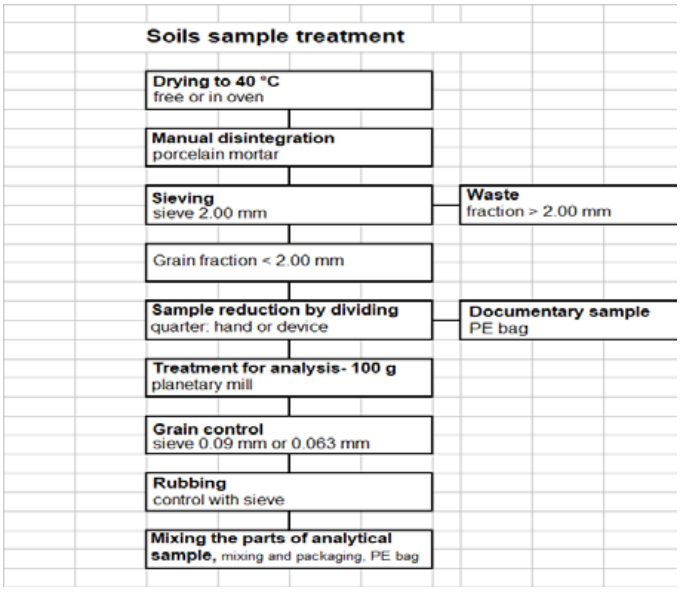


Fig. 20 Procedure for soil samples preparation in Slovakia

For plant samples Slovakia presents the following procedure (Annex 13):
1. If it is possible, in the case of sampling of a fresh product, sample preparation shall be carried out within 24 hours of sampling. If this is not possible, the sample is kept frozen (at most 6 weeks).
2. From the individual pieces, the soil, the heavily polluted and other external edible and damaged leaves are removed. The heavily soiled samples are washed and the surface dried with a paper towel.
3. The complete sample is homogenized according to the type of material (grinding on a plastic grinder, cutting mill) and the archive sample is stored in the freezer box.

IV.2. Chemicals

The chemical preparation of the samples is done in accordance with the method, the analysis technique and depends on the sample type (water, sediment, biota) Sample preparation, usually as part of analytical method (e.g. acid digestion, etc.) for the hazardous substance analyzed is in agreement with the matrix in which this is being analyzed (water, sediment, sludge). The most relevant parameters of the

extraction methods (the nature of the reagent according to type of sample, power for wave digestion, extraction time or temperature) are sets in analitycal quides. Generally all partners mention the same documents:

- For example, related to soil: Guidance Document No: 25 (Guidance on chemical monitoring of sediment and biota under the WF Directive 2000/60/EC) or ISO 11466:2004 (Soil quality -- Extraction of trace elements soluble in aqua regia, Pretreatment of samples for physicochemical analyses).
- For metal analysis in solids by **ICP-AES technique, or ICP-MS, or AAS** the following procedure is used: 100 mg of the sample is transferred to a Pt-dish, mixed with 2.5 ml HNO_3 (65%), 2.5 ml $HClO_4$ (60%) and 5 ml HF (40%). This solution is concentrated to near dryness. Then 5 ml HNO_3 (65%) is added to the residue and the solution is heated two times until all fumes evaporate. Finally, the residue is mixed with 0.5 ml HNO_3 (65%) and diluted with 50 ml H_2O. The following elements are measured: Li, Be, V, Cr, Co, Ni, Cu, Zn, Ga, Ge, As, Rb, Sr, Nb, Mo, Ag, Cd, In, Sn, Sb, Cs, Ba, Hf, Ta, W, Pb, Bi, U.
- For organic compounds and Hg in biota (fish, crustaceans and molluscs) laboratory treatment according to EN14996:2006 standard.
- Preparation of the sample and procedure for **XRD** measurements: Whole rock and clay mineralogy (< 2µm fraction) is determined by XRD at the Department of Mineral Resources of the Austrian Geological Survey (Annex 2). Samples for bulk mineral analysis are dried, ground and loaded into a sample holder as a randomly oriented powder. The semi-quantitative mineralogical composition is obtained by the SEIFERT AutoQuan software using the Rietveld method. Samples for clay mineral analysis are treated with 15% H_2O_2 for 24h in order to remove organic matter and subjected to ultrasound for further disaggregation. The <2 µm fractions are separated by centrifugation. The clay fractions are saturated with 1N KCl and MgCl solutions by shaking for 24h, and thereafter washed in distilled water. Oriented mounts of the <2µm fractions were made through the suction of 25 mg of suspended clay placed on a porous ceramic plate and left to dry at room temperature. Such oriented XRD mounts are subsequently analysed in air-dried, ethylene glycol, dimethylesulfoxide and glycerol treated states. The clay samples are run from 2 – 50 °2Θ using the same measurement setup, as in the case of bulk-rock samples. Identification of clay minerals was carried out according to Moore and Reynolds (1997). The clay minerals were identified by their basal (00l) diffraction lines on glycolated specimens of the Mg-treated samples. The relative percentages of the clay minerals in the fraction < 2 µm are determined after Schultz (1964).

- Preparation of the sample and procedure for **XRF** measurements: Sample preparation follows a standardized method involving crushing, grinding, sieving (disk mill - grain size <60 µm) and preparation of pressed pellets.
  1) Pellet analysis (5 g of a powder is homogenized and mixed well with 1 g of binder – wax, and then pressed with 20 tons to a 40 mm pellet).
  2) Fused bead analysis (0.5 g of a powder is homogenized with 7 g of Lithiumtetraborate and then fused at ~ 1100 °C to a 32 mm bead. For some materials a pre-oxidation may be necessary).
  3) Powder analysis (4 g of a powder is poured into a sample cup with an inner diameter of 32 mm. The bottom of a sample cup is covered with a 4 µm polypropylene film).

Accuracy and precision are ensured by the application of analytical standards. Major applied methods are certified according to ISO/IEC 17025 and other documents that provide analytical performance:
-ISO11929:2010 Determination of the characteristic limits (decision threshold, detection limit and limits of the confidence interval) for measurements of ionizing radiation – Fundamentals and application;
-JCGM 100:2008 Evaluation of measurement data – Guide to the expression of uncertainty in measurement;
-Measurement uncertainty. IAEA-TECDOC-1585, IAEA, Vienna 2008;
-Guide to expression of Uncertainty in Measurement. (GUM), 1995.ISO;
-"The Fitness for Purpose of Analytical Methods; A Laboratory Guide to Method Validation and Related Topics (ISBN 978-91-87461-59-0. Available from www.eurachem.org.).

Analytical results are verified by the use of certified substances or materials (CRMs) or by interlaboratory comparisons. The list of equipment (combined systems) for analysis (IV.2.2-IV.2.8 in the questionnaires) is presented in table 37.

IV.2.1. Procedure for organic matter

The content of organic matter (humus) in the soil is established by calcining to constant weight.
The GC-MS procedure for organic compounds content determination in sediment (PAH, inorganic compounds, PCB, dioxins, PBDE, DEHP, nonylphenol, octylphenol, triclosan, triclosan-methyl, AHTN, HHCB and others) is listed in in most of the questionnaires.
Bulgaria (Annex 5):

- water (BSS EN 1484:2001);

- total organic carbon; dissolved organic carbon; soil/ sediment (BSS ISO 14235:2002);
- soil quality; organic carbon determination by sulfo-chrome oxidation.

IV.2.2. ICP-MS, ICP-AES systems

By ICM-MS method, according to ISO 17294, the following elements are measured: Li, Be, V, Cr, Co, Ni, Cu, Zn, Ga, Ge, As, Rb, Sr, Nb, Mo, Ag, Cd, In, Sn, Sb, Cs, Ba, Hf, Ta, W, Pb, Bi, U. By EPA 6020 the following elements are measured: As, Al, B,Co,Cr, Cu, Fe, Ni, Pb, Zn, Sb. The detection limit depends on each element, ranging in the interval 0.1µg/l - 1 µg/l for trace elements and 1 - 50 µg/l for alcalynes.The countries list of ICP-MS instrument systems is shown in Table 37.

ISO 17294-1:2004 Water quality -- Application of inductively coupled plasma mass spectrometry (ICP-MS) specifies the principles of ICP-MS and provides general directions for the use of this technique for determining elements in water. Generally, the measurement is carried out in water, but gases, vapours or fine particulate matter are described in the separate parts of ISO 17294.
ISO 17294-2:2016 specifies a method for the determination of the elements aluminium, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, caesium, calcium, cerium, chromium, cobalt, copper, dysprosium, erbium, gadolinium, gallium, germanium, gold, hafnium, holmium, indium, iridium, iron, lanthanum, lead, lithium, lutetium, magnesium, manganese, mercury, molybdenum, neodymium, nickel, palladium, phosphorus, platinum, potassium, praseodymium, rubidium, rhenium, rhodium, ruthenium, samarium, scandium, selenium, silver, sodium, strontium, terbium, tellurium, thorium, thallium, thulium, tin, tungsten, uranium and its isotopes, vanadium, yttrium, ytterbium, zinc and zirconium in water (for example, drinking water, surface water, ground water, waste water and eluates). Taking into account the specific and additionally occurring interferences, these elements can also be determined in digests of water, sludges and sediments (for example, digests of water as described in ISO 15587 1 or ISO 15587 2).
The working range depends on the matrix and the interferences encountered. In drinking water and relatively unpolluted waters, the limit of quantification (xLQ) lies between 0.002 µg/l and 1.0 µg/l for most elements. The working range typically covers concentrations between several pg/l and mg/l depending on the element and pre-defined requirements.

The following standards are also used:
- EN 1617l 2016 - Processed sediment and soils. Element determination with (ICP-MS).

- EN ISO 11885 (75 7466) - Determination of Ag, Al, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Si, Sn, Sr, Ti, V, Zn in water and aqueous extracts (ICP-OES).

In Serbia EPA Method 8270 D:2014 is used for semi-volatile organic compounds by GasChromatography/Mass Spectrometry. The limits of quantification are listed in Annex 12.

IV.2.3. AAS systems

By AAS method, according to ISO 12020 the trace elements (Ni, Cd, Pb, Cr, As, Cu) are measured in water. The detection limit depends on each element, being between 0.05 µg/l and 0.5 µg/l, and for all elements there is an analitycal standard.

According to ISO 11047/1998 - Soil quality -- Determination of cadmium, chromium, cobalt, copper, lead, manganese, nickel and zinc are performed by flame and electrothermal atomic absorption spectrometric methods.

AAS-systems equipped by Flame, (flame atomic absorption spectrometry), THGA and Hydride Generation System (FIAS400), GFAAS (Graphite furnace atomic absorption spectrophotometry) for Pb and CVAAS analyzer for Hg (according to EPA 245.7) are listed in Table 37.

It is also used EPA Method 245.7 - Mercury in Water by Cold Vapor Atomic Fluorescence Spectrometry.

IV.2.4. XRF

The elements and/or compounds (HSs) measured by XRF are: Al_2O_3, As, Ba, CaO, Cr, FeO, K_2O, MgO, MnO, Na_2O, Ni, P_2O_5, Pb, Rb, SiO_2, Sr, V, Y, Zn and Zr. The detection limit for metals is 1ppm and for oxydes 0.01%-1%.
ISO 18227:2014 (Soil quality - Determination of elemental composition by XRF) specifies the procedure for a quantitative determination of major and trace element concentrations in homogeneous solid waste, soil, and soil-like material by energy dispersive X-ray fluorescence (EDXRF) spectrometry or wavelength dispersive X-ray fluorescence (WDXRF) spectrometry using a calibration with matrix-matched standards.

ISO 18227:2014 is applicable for the following elements: Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Br, Rb, Sr, Y, Zr, Nb, Mo, Ag, Cd, Sn, Sb, Te, I, Cs,

Ba, Ta, W, Hg, Tl, Pb, Bi, Th, and U. Concentration levels between approximately 0,0001% and 100% can be determined, depending on the element and the instrument used.

ISO 12677 - Determination of SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, TiO_2, MnO, K_2O, Na_2O, P_2O_5 in geological material, soils, sediments, sludge by XRF.

ISO 17225 (1-7) - Determination of As, Ag, Ba, Bi, Br, Cd, Ce, Cl, Cr, Cs, Cu, Ga, La, Mo, Nb, Ni, Pb, Rb, Sb, Se, Sn, Sr, Te, Th, U, V, W, Y, Zn, Zr in geological material, soils, sediments, sludge by XRF.

IV.2.5. DC-arc - AES

No answers in the questionnaires.

IV.2.6. Radionuclides

In Bulgaria, the situation is summarized in Table 35 (Annex 5).

Table 35 - Radionuclides measurement in Bulgaria

Parameter in water	Standard	Method
Gross alpha activity	BSS ISO 9696 (1 2 3.4)	Test method using thick source
Gross beta activity	BSS ISO 9697 (1 2 3.4)	Test method using thick source
Uranium	VIM 1020/2010 (1,2 3.4)	Spectral-photometric
Radium-226	BSS 12575 (1 2,3.4)	
Tritium	BSS EN ISO 9698 (1,2 3,4)	Liquid scintillation counting method
Radon - 222	VIM 1021/2010 (1 2 3.4	
activity concentration of radionuclides	EN ISO 10703 (1,2,3,4) - Water quality - Determination of the activity concentration of radionuclides - Method by high resolution gamma-ray spectrometry	
Specific activity of gamma emitting - radionuclides (238U, 226Ra, 232Th, 230Th, 210Pb, 40K, 137Cs,	ISO 18589-3	gamma-ray spectrometry

Parameter in water	Standard	Method
134Cs, 60Co et al., exposition up to 24 h		

Further explanations for the above table:

- ISO 9696:2017 - Water quality - Gross alpha activity.
- ISO 9697:2017 - Water quality - Gross beta activity in non-saline water - Test method using thick source.
- ISO 9698:2010 - Water quality -- Determination of tritium activity concentration -Liquid scintillation counting method.
- Natural uranium - VIM 1020/2010 (1, 2, 3, 4) - Methodology for determination of uranium in waters – spectrophotometric.
- VIM 1021/2010 (1 2 3.4) – Methodology for volume activity/concentration in water – spectrophotometric.
- БДС EN ISO 10703 (1, 2, 3, 4) - Water quality - Determination of the activity concentration of radionuclides - Method by high resolution gamma-ray spectrometry.
- ISO 18589-3 - Measurement of radioactivity in the environment - Soil - Part 3: Test method of gamma-emitting radionuclides using gamma-ray spectrometry (ISO 18589-3:2015, Corrected version 2015-12-01) in radiological laboratories.

In Croatia (Annex 7) radionuclide monitoring in water, sediment and biota, at country level, is performed by the Institute for Medical Research and Occupational Health, Zagreb.

- Gamma-ray spectrometry measurements were carried out using an ORTEC High-Purity Germanium Coaxial Photon Detector System comprising a GMX type detector (relative efficiency of 74.2% and peak full width at half maximum of 2.24 keV, all at 1.33 MeV 60 Co). The detector system measures gamma rays in the energy range between 40 and 2000 keV, which covers the gamma ray emissions of the studied radionuclides. Energy and efficiency calibrations were performed using certified calibration sources obtained from the Czech Metrology Institute.
- Canberra HPGe "P"-TYPE detector measures **radionuclides** ^{40}K, ^{137}Cs, ^{134}Cs, ^{232}Th, ^{238}U, ^{226}Ra, ^{228}Ra, ^{210}Pb, ^{235}U, with detection limits depending on the time of analysis, media type, radionuclide itself and used instrument.
- Accuracy and precision are ensured by the application of analytical standards. The majority of the applied methods are certified according to ISO and other documents that provide analytical performances.
- The standards of the Czech metrology institute were used to adjust the measurement system, while quality control was performed through regular

participation in inter-laboratory comparisons organized by the International Atomic Energy Agency, the World Health Organization and the EU Joint Research Center.

In Ukraine (Annex 15):

- Radionuclides in water are measured with QUANTULUS-1200 spectrometer DSTU ISO 9696-2001 (H3, Rn222, Ra226, Ra228, U, β, α);
- Radiometer of alpha-active gases РГА 03 (Альфа -1М). ISO 13165-1: 2013 (Ra226, U). "Instruction and methodological guidelines for the assessment of the radiation situation in the contaminated area" Goscomgidromet of the USSR, August 17, 1989 (Sr90).
- For bottom sediments, soils and biota: gamma-spectrometric complex based on the multichannel analyzer NOKIALP 490 with a semiconductor detector of the type DGDK-220 (226Ra, 232Th, 40K, 137Cs, 134Cs and others).

In Serbia (Annex 12), the radionuclides are measured in water and sediments, according to the standards presented in Table 36.

Table 36 - Radionuclides measurement in Serbia

Water	Standard
Analysis of radionucleide content (Gamaspectrometric analysis)	TRS 295:19891
Analysis of radionucleide content (Gamaspectrometric analysis)	ISO 9696:1992
Measuring of total alfa and beta radioactivity	ISO 9697:1992
Determination of Sr-90 activity by β radiation measurements	ВДМ 02:19723

Sediments	Standard
Analysis of radionucleide content (Gamaspectrometric analysis)	ISO 18589-3:2011
Measuring of total alfa and beta radioactivity	MARLAP:2004
Determination of Sr-90 activity by β radiation measurements	ВДМ 02:1972

Total β radioactivity is measured (Bq/l).No data about detection limits is available.

IV.2.7. Organic compounds (HSs)

The GC-MS procedure for organic compounds content determination in sediments (PAH, tinorganic compounds, PCB, dioxins, PBDE, DEHP, nonylphenol, octylphenol, triclosan, triclosan-methyl, AHTN, HHCB and others) is listed in in most of the questionnaires.
Organic compounds in biota: GC-MS; HRGC/HRMS for PBDE and dioxins; LC-MS/MS for PFOS and HBCDD.
Organic compounds in water and sediments: GC-MS, GC-MS/MS and LC-MS/MS.

The Priority Substances relevant according to the Water Framework Directive are:
-**Pesticides** (herbicides, insecticides): Aclonifen, Bifenox, Cypermethrin, Dicofol, Heptachlor, Heplataclorepoxide, Quinoxyfen, Cybutrine, Dichlorvos, Tetrabutryn;
-**Industrial chemicals**: Perflourooctane sulfonic acid (PFOS), Hexabromocyclo-dodecane (HBCDD);
-**Combustion by-products**: Dioxins and dioxin-like PCB-s;
-**Pharmaceutical substances** (steroids-hormons): 17-alpha-ethinylestradiol, 17-beta-estradiol, Diclofenac;

The associates standardized Analytical Methods for measuring pesticides and for **organic industrial pollution** are indicated in all countries questionares (and the PSs are listed in the national legislation) for water and digested soil and sediments. Usually, these standards are:
- **EPA 8270** for **16 Pesticides (herbicides, insecticides)**: Aclonifen, Aldrin, Bifenox, Cypermethrin, Chlorpyrifos (-ethyl, -methyl), DDT (including DDE, DDD), Dicofol, Dieldrin, Endrin, Heptachlor, Heplataclorepoxide, Quinoxyfen, Cybutrine, Dichlorvos, Tetrabutryn, Trifluralin + Hexachlorobenzene, Hexachlorocyclohexane.
- **EPA 8280B** for **combustion by-products**: **Dioxins and dioxin-like PCB-s**
- **EPA 1698** for **steroids** 17-alpha-ethinylestradiol, 17-beta-estradiol
- **EPA 542** for **some pharmaceutical substances** (Hormon, Diclofenac)
-**EN 16181:2018** for **Polyaromatic Hydrocarbons**: Anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)-pyrene, Fluoranthene.

A very detailed list of organic compounds and associated ISO standards, including LOD, LOQ measurement uncertainty for water, sediment, biota, is available in the Croatian questionnaire (Annex 7) on pages 15-25.

Usualy compounds with a log Kow>5 (octanol-water) should preferably be measured in sediments, or in suspended particulate matter (SPM), while compounds with a log

Kow<3 should preferably be measured in water. Information about log Kow can be linked to informations about BCF or BAF. Sediment and water information can be linked to biota.
It has been determined that substances with a molecular weight (MW) > 1100 are too large to cross membranes into the organism and the equivalence (generally accepted) is the relationship between BCF 5000 criterion and log Kow:

$$5.0 < \log Kow < 7.5 \textbf{ and } MW < 1100$$

where:
BCF - bioconcentration factor
BAF - bioaccumulation factor
log Kow - logarithm to base 10 of the octanol / water partition coefficient.

IV.2.8. XRD

For all methods and elements the analytical standards are listed in the country questionaires.The detection limits are also listed and in many cases the accuracy too. The complete list of available laboratory equipments (IV.2.2-IV.2.7.) is presented in a synthetic (in combination with the analytical method) in Table 37.

IV.3. Inventory of national laboratories

Accredited laboratories in Austria (Annex 2) :MAPAG, PorrUmwelttechnik, Wruss, Seibersdorf, NUA, CEWE.
The list of Moldavian accredited laboratories (Annex 9), where HSs are analyzed, is presented in national language on http://www.acreditare.md/public/files/registre/1-Registru-LI-28.12.2018.pdf

IV.4. Good practices

In Germany (Annex 6) it is mentioned a national guidance “Länderarbeitsgemeinschaft Wasser, RaKon Arbeitspapier IV.4”, where a procedure for calculating water concentrations from SPM-concentrations is described for highly accumulative substances.
AA-EQS for water for PCB and triphenyltin-cation will only be used when the analysis of sediment/SPM is not possible (Germany, Annex 6).

Many national guides provide also the concentration of an atomic element and the concentrations of its compounds in order to identify traceability, bioaccumulation, and determine the actual toxicity produced by the presence of a metal in the aquatic environment.

IV.5. Protocols

Moldova (Annex 9) lists 12 protocols developed within various projects for inter-laboratory comparison related to:

- determination of metals (cadmium, copper, nickel, iron, lead, manganese, chromium, zinc) and determination of organo-chlorinated pesticides and polychlorobiphenyls in soil, rocks and plants;
- determination of calcium, magnesium, chromium, strontium, sodium and potassium in water;
- determination of organochlorinated pesticides and polychlorobiphenyls in water and raw materials.

For the parameters for which the laboratory has accreditation, the laboratory also participates in inter-laboratory comparative schemes (Aquacheck, Aglae, QualcoDanube, Quasimeme, etc).

IV.6. CONCLUSIONS

The list of laboratory equipment includes analytical instrumentation systems dedicated to analyzing trace elements using ICP-MS, ICP-AES, F-AAS, GF-AAS, AAS-with hydride generators, XRF-spectrometry, mercury analyzers using CV-AAS or C-ASA.

All chemical trace or major elements mentioned in the legislative guidelines for environmental quality assessment (water, soil, sediment, biota) in the atomic state can be analyzed with existing equipment. For all analyzes there are analytical guides, especially ISO and EPA.

More detailed identification of minerals in sediments is realized, for example, using electron microscopy (SEM, TEM) and electron microanalysis or X-ray powder diffraction analysis.

As is known from literature, each technique is associated with certain elements and matrices, so that, having several types of equipment offers the possibility to perform high quality analyzes.

There is the possibility of intercomparison and intercalibration between laboratories, and the experience of developing the protocols for these comparisons is reported.

The list of laboratories equipment includes also hyphenated instrumental systems such as high-resolution gas chromatography/high-resolution mass spectrometry

(HRGC/HRMS), gas chromatography mass spectrometry (GC-MS), liquid chromatography mass spectrometry (LC-MS), dedicated to methods of analysis of organic compounds that are listed in the legislation for environmental quality assessment (water, soil, sediments, biota).
For these parameters all analyzes are also standardized (ISO or EPA). The number of these compounds is large and variable, depending on the country, and a selection of the parameters of interest is required, correlated with the reports on the sources of pollution (especially the wastewater discharges) when the criteria list is drawn up for SIMONA.

The complete list of available laboratory equipments is synthetically presented (in combination with the analytical method) in table 37.

Table 37 - List of analytical methods and equipments

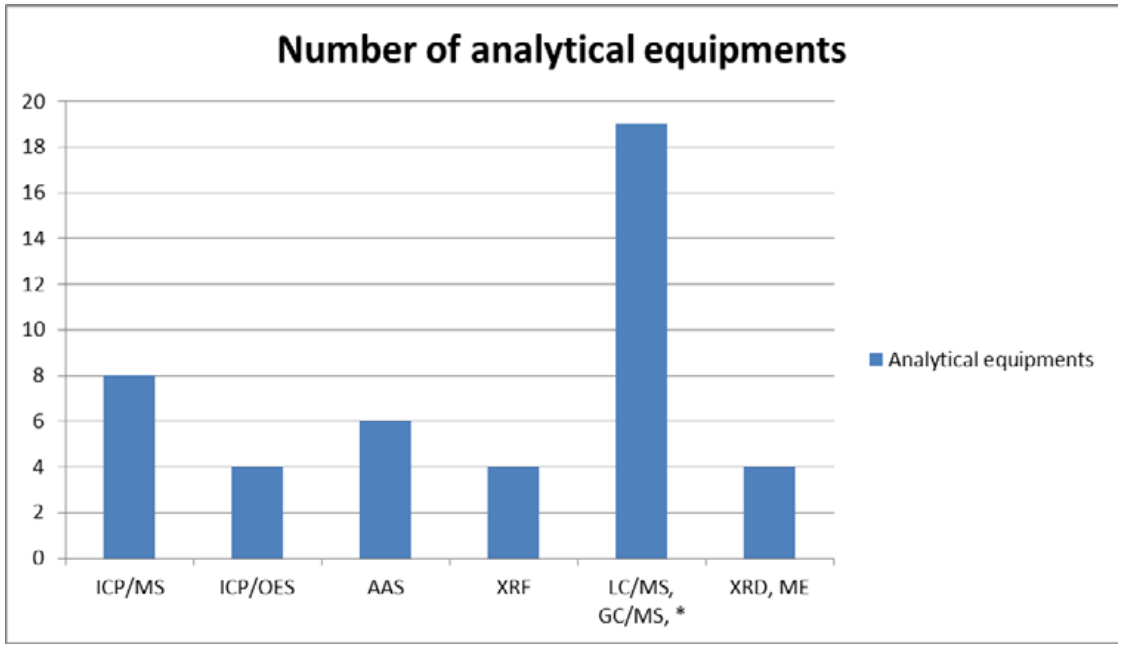
Country	ICP-MS	ICP-AES	AAS	XRF	XRD/SEM,TEM	Instrument for organic compounds (HSs)
AT	ICP-MS 7500 Agilent	-	-	Epsilon 5 PANAnalytical	X-Ray diffraction: PANalytical X'Pert Pro Powder	-Mettler Toledo T 70 (for HCO3) - ICS-2000 Dionex (for Cl-, SO4-2, NO3-, F-) - C/S analyzer LECO CS-200 (for total carbon and total sulphur)
BA	-	-	-	-	-	-
BA-SRP	-	-	AAS, flame and graphite technique, Shimadzu FAAS AA6300 and Hg analyser AMA 254.	-	-	-
BG	ICP-MS	-	Flame AAS	-	-	GC-MS
HR	ICP-MS, Perkin Elmer ELAN 9000 and ICP QQQ 8900 Agilent Technologies	-	-(CV-AAS for mercury).	-	-	Biota: GC-MS; HRGC/HRMS for PBDE and dioxins; LC-MS/MS for PFOS and HBCDD

Country	ICP-MS	ICP-AES	AAS	XRF	XRD/SEM,TEM	Instrument for organic compounds (HSs)
						Water and sediment: GC-MS, GC-MS/MS and LC-MS/MS.
DE	ICP-MS	-	-	-	-	GC-MS
HU	-	-	-	-	-	-
MD	-	-	-	Equipment AAnalyst800, Perkin Elmer Inc, by Plame, THGA and Hydride Generation System (FIAS400)	-	-
ME	-	-	-	-	Olympus SZX10 binocular brand and the Olympus CX23 microscope for biota samples optic analysis	-
RO	-	ICP-AES Baird 2070	Hg analyzer Hydra –II And CC (Teledyn)	-EDXRF-Minipal4-PANalytical -Portable XRF Olympus DELTA DPO-6000	- Shimadzu 6000 X-ray diffractometers - INEL Equinox 3000 X-ray diffractometer - microscope JEOL JSM 5600 LV -ME Gemini II-Carl Zeiss	-
SR	ICP-MS, Perkin Elme	Perkin ElmeICP-	FAAS, AAS-ETA Perkin Elmer	-	-	Water and sediment: GC-MS, GC/MSD

Country	ICP-MS	ICP-AES	AAS	XRF	XRD/SEM,TEM	Instrument for organic compounds (HSs)
		OES, Perkin Elmer	Flow Injection Mercury/Hydride Analyses Using Perkin Elmer FIAS-100			
SK	- ICP-MS Aurora M90 Bruker - ICP-MS Agilent 7900	- ICP-OES 5100 Agilent - ICP-OES 5110 Agilent	- AAS AMA- 254, Altec Prague (Hg in water) - AAS AMA- 254, Altec Prague (Hg in soils) - Agilent AA Dou 240FS/ 240Z (Au, Ag in geological materials)	-Energy dispersive XRF (X-ray fluorescence) spectrometers – SPECTRO XEPOS	-	-Agilent 7890B GC-FID -Varian 3900 GC-FID -Varian 450-GC GC-ECD -Agilent 7890B GC-MSD -Agilent 597B GC-MS -Agilent 7010B GC-MS Triple Quad -Agilent Infinity 1260 HPLC-DAD/FLD -Agilent 6470 LC/MS Triple Quad
SI						

Country	ICP-MS	ICP-AES	AAS	XRF	XRD/SEM,TEM	Instrument for organic compounds (HSs)
UA			TERMOSIENIFICSOLAAR 6M (England) AASsystems (AAS-ETA; F- AAS)			

Gas chromatography with Flame-ionization detector (GC-FID),
Gas chromatography with Electron Capture Detector (GC-ECD),
Gas chromatography Mass Spectrometry (GC-MS),
Gas chromatography Tandem Mass Spectrometry (GC-MS/MS),
High Performance Liquid Chromatography with Diode Array Detector and Fluorescence Detector (HPLC-DAD/FLD);
Liquid Chromatography Tandem Mass Spectrometry (LC-MS/MS)



** - other equipments that analyze organic compounds*

Fig. 21 Number and types of analytical equipments in SIMONA countries

V. INVENTORY OF EVALUATION METHODS

V.1. Establishing threshold values for HSs

This question refers to how threshold values for HSs are set in each type of media (sediment, water, biota (e.g. average of the last measured values, average with the treatment of outliers, average of the values measured in areas without anthropogenic influence, enrichment factor, conservative elements for normalization, etc.).

BULGARIA: Quality standards for priority substances and other specific pollutants are defined by the Regulation of the Ministry of the Environment and Water, Bulgaria. They refer to surface water and partly to biota, whereas for sediments there are no such standards. An average annual value is used, which means that for each representative monitoring site for a water body, the arithmetic mean value of the concentrations measured at different times of the year does not exceed the value set in the standard. A maximum permissible concentration is also used, which means that the measured concentration at any point of monitoring within the water body does not exceed the standard.

REPUBLIC OF MOLDAVIA: The threshold values for soil were set for the territory of the country after analyzing the publications about the analysis of trace elements in different objects. This work was made in Soviet time for all regions of former USSR including Republic of Moldavia. Other source for evaluating trace elements threshold values is represented by the reference sources as Klark values.
The organic HSs should to be on zero level, because they are artificial substances.

BOSNIA AND HERZEGOVINA (REPUBLIC OF SRPSKA): Threshold values are harmonised with WFD, which means that there were no investigations which would set specific threshold values.
Threshold values for HSs are set only for water samples, which is stated in the Regulation on water classification and categorization of water courses (Official Gazette of Republika Srpska 41/01), and available at http://www.voders.org/propisi-i-obrasci/pravna-regulativa

HUNGARY: Environmental Quality Standards (EQSs) are delivered for the surface waters and biota according to EU-WFD. AA-EQS for annual average concentrations

and MAC-EQS for maximum acceptable concentrations. HU has three status classes for metals: 1) bellow natural background, 2) good status, 3) bad status; and two classes for other priority (hazardous) substances: 1) good status, 2) bad status. In some cases, HU uses EQSadded based on added risk aproach, when the ABC (ambient background concentration) is known.

Surface water status assessment: Art. 16 of the WFD sets out the strategy to prevent chemical pollution of Surface Waterbodies (SW). The chemical status assessment is used alongside the ecological status assessment to determine the overall quality of a waterbody. Environmental Quality Standards (EQSs) are tools used for assessing the chemical status of waterbodies. The EQS Directive (2008/105/EK and 2013/39/EU) established

- the maximum acceptable concentration (MAC-EQS) and/or
- annual average concentration (AA-EQS)

for 45 priority substances and 8 other pollutants which, if met, allows the chemical status of the waterbody to be described as 'good'.

Criteria of high confident:

- Do we analyse
  - all of PSs identified as being discharged into the body of water; and
  - all relevant PSs min. 12 times (1/month) during 1 year; and
  - all of other substances identified as being discharged in significant quantities into the body of water; and
  - all relevant other substances min. 4 times (each 3 months) during 1 year?
- And all LOQs ≤ 0.3 · EQSs?

ROMANIA: For soils there are 4 sets of values correlated with the soil type, without taking into account the soil composition.

For waters there is only one set of values (the geological particularities and water hardness are not specified).

For sediments (with 10% organic matter and specified granulometric class according to Order 161/2006), the contents of few toxic metals are set. There is no reference to the geological background.

SLOVAKIA: Quality standards for priority substances and other specific pollutants are defined by the Regulation of the Ministry of the Environment in Slovakia. They refer to surface water and groundwater, soils, whereas for sediments there are no such standards.

There are two sets of thresholds values for groundwater (in quaternary sediments and in prequaternary rocks).

There are three sets of values for soil:

A – reference value;

B – indication value (if value exceeded, site monitoring is required);

C – intervention value (if value exceeded, remediation measures are required).

There are three sets of limit values of risk elements in agricultural soil depending on soil types (sand, silt, clay).

For sediments there are four sets of values which refer to hazardous substances:

TV – target value – negligible risk, undisturbed natural environment, uncontaminated sediment and 100% survival of aquatic organisms, represents 1/100 MPC);

MPC – maximum permissible concentration – represents the maximum permissible risk, the level ensuring the survival of 95% of all species of organisms in the given ecosystem;

TVd – tested value – the environmental risk is not expressed, the value lies in the interval between MPC and IV can be used for deciding on sediment management;

IV – intervention value – represents a serious risk; the concentration of a substance in which only 50% of all species of the ecosystem are protected.

An overview of legislation for management of sediments on the basis of the limit values of selected elements in sediments (sediment leachates) is presented in Table 38.

Table 38 – Example of thresholds for sediments in Slovakia

Indicator	Act no. 188/2003 Coll.	Decree of the MoA and MoE no. 257/2009	Decree of the MoE no. 372/2015		EPA "RCRA"
	Total content [mg.kg^{-1}]	extraction with the HNO_3 (Hg total content) [mg.kg^{-1}]	Aqueous extract [mg.l^{-1}]		TCLP extract [mg.l^{-1}]
			non-hazardous waste landfill; leachability class II.	hazardous waste landfill; leachability class III.	
As	20	30	0,2	2,5	5
Sb	-	-	0,07	0,5	-
Cr	1000	200	1	7	5
Hg	10	0,8	0,02	0,2	0,2
Ni	300	80	1	4	-
Pb	750	100	1	5	5
Cd	10	1	0,1	0,5	1

Indicator	Act no. 188/2003 Coll.	Decree of the MoA and MoE no. 257/2009	Decree of the MoE no. 372/2015		EPA "RCRA"
	Total content [mg.kg^{-1}]	extraction with the HNO_3 (Hg total content) [mg.kg^{-1}]	Aqueous extract [mg.l^{-1}]		TCLP extract [mg.l^{-1}]
			non-hazardous waste landfill; leachability class II.	hazardous waste landfill; leachability class III.	
Cu	1000	100	5	10	-
Zn	2500	300	5	20	-

Median + 2MAD value is used, if statistical approach is possible (for water bodies or groundwater bodies) - spatial data with high density, comparison with monitoring data is taken into consideration (arithmetic mean or maximum value of the concentrations measured at different times of the year). For water bodies with data gap, an analogue approach or scientific estimate is used. For groundwater the background values are firstly calculated for each GW body. Then the threshold value usually represents the mean between standard value and background value.

SLOVENIA: The environmental quality standards (EQS) are defined as the maximum permissible concentration that protects against acute poisoning and as an average annual value that protects against chronic influenza according to WFD.

GERMANY: Environmental Quality Standards are derived according to EU rules (WFD implementation).

V.2. Fixed or variable threshold values for HSs

This question refers to the type of threshold (fixed or variable) and if the threshold values depend on on the sample form, drainage basin lithology, time of the year or some other parameter.

BULGARIA: The quality standard values are fixed, but when assessing the results of the monitoring for different quality standard, Basin Directorates can take into

account the natural background concentrations of metals and their compounds, water hardness, pH, dissolved organic carbon and other water quality parameters.

CROATIA: Threshold values for inorganic compounds are set according to WFD, but due to specific geology, there is the possibility that some of these values should be revised. For example (Table 39), the metal threshold values for agricultural soil in Croatia are set based on pH, organic content, correlated with their composition (sandy, clayey or silty soils).

Table 39 – Metal threshold values for agricultural soils in Croatia

mg/kg	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Sandy soil	0,0-0,5	0-40	0-60	0,0-0,5	0-30	0-50	0-60
Silty-clayey soil	0,5-1,0	40-80	60-90	0,5-1,0	30-50	50-100	60-150
Clayey soil	1,0-2,0	80-120	90-120	1,0-1,5	50-75	100-150	150-200

For Cd, Zn and Ni, if pH of clayey soil is under 6, than threshold value for silty-clayey soil is applied, and if pH of silty-clayey soil is under 6, then threshold value for sandy soil is applied.
For Pb and Cr, if pH of clayey soil is under 5, then threshold value for silty-clayey soil is applied and if pH of silty-clayey soil is under 5, then threshold value for sandy soil is applied.
For Hg and Cu, if organic content of clayey soil is under 3%, then threshold value for silty-clayey soil is applied, and if organic content of silty-clayey soil is under 3%, then the threshold value for sandy soil is applied.

HUNGARY: The EQS values are fixed, but when criteria of Good status (1) Annual avarage concentration < AA-EQS? and (2) Maximum concentration < MAC-EQS? are not met; then (if it is possible) HU use the following EQS-corrections:

- bioavailabiltiy concentration of metals
- natural background concentration of metals
- local EQSs in mixing zones

EQSs for different spatial scales:

- EU level – EQSgeneric (2013/39/EU): protect min. 90% of EU waterbodies
- National/regional level – EQSregional: protect min. 90% of the WBs in the region
- Local level – EQSlocal: protect one waterbody or one group of waterbodies

SERBIA: Threshold values for inorganic compounds are set according to WFD, some of these values should be revised.

REPUBLIC OF MOLDAVIA: The threshold value were evaluated for different soil types, depending on the granulometric and organic content.

SLOVAKIA: The quality standard values are fixed for specific water management plan. After new data collection the values can be revised. We take into account the natural background concentrations of metals and their compounds, water hardness, pH, dissolved organic carbon and other water quality parameters. It means, we take into consideration drainage basin lithology.

SLOVENIA: The environmental quality standards are generally fixed. For some metals (Cd, B, Hg, Cu, Zn, Co, Sb) the natural background and bioaccumulation (Ni and Pb) are taken into account.

BOSNIA AND HERZEGOVINA (REPUBLIC OF SRPSKA): Threshold values are fixed, although some of them cover specific range

ROMANIA: The quality standard values are fixed, but they may depend on lithology if there are very large differences in the substrate.

V.3. Corrections for threshold values

The question refers to the corrections that may be applied to threshold values (amount of quartz, organic matter etc.).

SERBIA: Corrections are applied in the case of sediments where organic matter content and particle size fractions are taken into account during the determination of threshold values.

MOLDOVA: Corrections are applied by additional analyses that are made: granulometry, organic content.

SLOVAKIA: No correction for water. In case of results interpretation for sediments (but in Slovakia there are no threshold values) we use corrections (granulometry, organic matter content).

V.4. Basis of the environment quality objectives

This question aims to find out if the environmental quality objectives are based on measuring the total metal concentration and / or some dangerous compounds of that metal in different valence states.

BULGARIA: For most metals, the total metal concentration is measured. For chromium the 3- and 6-valence form is measured. For some elements such as Cd, Cu, Zn, quality standards vary depending on the water hardness.

CROATIA: Total metal concentration.

SERBIA: Total metal concentration.

MOLDOVA: The total content and different mobility forms of inorganic HSs were analysed for different type of soils for the country area in the past.

BOSNIA AND HERZEGOVINA (REPUBLIC OF SRPSKA): Only total metal concentrations are measured. It seems that there are no differentiation between concentrations of geogenic and anthropogenic origin. For example, strongly bounded metals vs weakly bounded metals.

HUNGARY: For most metals, the dissolved (<0,45 µm) total metal concentration is measured. For chromium the 3- and 6-valence form is tried to measure. For Cd the quality standards vary depending on the water hardness. And for some elements such as Cu, Zn, Pb, Ni usually bioavalilable EQS-corrections are used. For As and Hg usually the ABC (ambient background) EQS-corrections are used.

SLOVAKIA: The mobility of the elements (mainly potentially toxic trace elements) is experimentally evaluated by several approaches. These are, in particular, extraction experiments in laboratory conditions that imitate the changing conditions in the environment and help predict the risk of element mobilization from solid sediment phases. The most relevant parameters of the extraction methods are the nature of the reagent (type of substance, power), extraction time (from several hours to the days), or temperature. In Slovakia several one-step extraction methods and sequential extraction methods were tested.
For most metals, the total metal concentration is measured. For chromium the 3- and 6-valent form is measured. For some elements such as Cd, Cu, Zn, quality standards vary depending on the water hardness.

SLOVENIA: For most metals, the total metal concentration is measured. For some elements such as Cd, Cu, Zn, environmental quality standards vary depending on the water hardness.

UKRAINE: To estimate the level of contamination, the gross concentrations of elements in the bottom sediments are mainly used; sometimes for Cr the estimation based on the valence value is used. This is done in the case when Cr is the leading contamination element.

V.5. “Bioaccumulation” in legislation

This question refers to the way the legislation reflects the phenomenon of “bioaccumulation” and if the biota type is correlated with the ecosystem.

BULGARIA: The European directives and guidelines referring the term "bioaccumulation" are adopted and applied.
MOLDOVA: The phenomenon of “bioaccumulation” is not reflected in the legislation. It is studied in scientific projects and publications.

SLOVENIA: For Ni and Pb, the environmental quality standards relate to biologically available concentrations of substances as dictated by Directive 2013/39/EU and instructions prepared at EU level. In Slovenia the bioaccumulation is studied in expert documents.

UKRAINE: The Ukrainian legislation does not reflect the phenomenon of bioaccumulation. Only the method of MPC for the toxic elements in food products is used.

V.6. Categories of environment quality in national legislations

The question has the purpose to find out if there are in the national legislative acts categories of environment quality based on deviations from threshold values.

BULGARIA: Environmental quality categories for surface water characteristics are defined by Regulation No. H-4 14.09.2012. Five categories are established: excellent, good, moderate, bad, and very bad ecological status.

CROATIA: There are some specific categories (for example those stated in I.2), but only for individual indicator.

HUNGARY: For Priority substances and for Priority hazardous substances two status classes are defined: (1) Good and (2) Bad. These classes are used for metals, but also metals have one more class (0) Bellow background, which is almost the same as excellent class of ecological status.

MOLDOVA: The legislation determines classes for water objects.

SERBIA: Waterbody status is determined based on the deviations from the limit values. The limit values themselves are determined according to typology.In addition to that, 5 different water classes exist (based on which purposes the water can be used for), depending on the deviation from the limit values.

SLOVENIA: The limit values for the ecological status of rivers and lakes, expressed as a ratio of ecological quality, are determined in the Decree on the status of surface waters – its Annex 6. There are defined 5 classes: excellent, good, moderate, bad, and very bad ecological status. For chemical status of water there are defined 2 classes: good and excellent.

ROMANIA: The waterbody status is determined based on the deviations from the limit values and there are 4 quality classes.

UKRAINE: There are categories only for drinking and surface waters which provide the water supply of the population.

V.7. Number of media for defining the categories of environment quality

The question regards the fact if the categories of environment quality could be defined by quality of more than one medium.

BULGARIA: The assessment of the ecological status of surface water bodies is based on developed classification systems for the assessment of individual type-specific quality elements. A set of hydrobiological monitoring data, physicochemical analysis related to biological quality elements, a set of specific pollutants defined at national level, as well as hydromorphological changes are used.

CROATIA: There are no multivariate indicators.

HUNGARY: EQSs for different Matrices:

- Water samples
  - whole
  - dissolved (0.45 µm glass-fibre filters)
  - bioavailable
- Sediment
  - bottom
  - suspended particular matter (SPM)
- Biota
  - fish, mussels or seabird eggs

SERBIA: There are no multivariate indicators.

MOLDOVA: Classes of water objects are determined in GOVERNMENT DECISION Nr. 890 from 12.11.2013 for the approval of the "Regulation on Environmental Requirements for Surface Waters".

ROMANIA: There are quality categories for soils and water.

SLOVENIA: For the chemical status of surface waters the environmental quality standards are defined for water and for biota.

UKRAINE: There are methods for a complex environmental assessment, but they are not official (not approved at the State level).

V.8. Algorithm for defining the environment quality categories

The question refers to the algorithm (e.g. weight coefficients) used for determining the environment quality categories.

BULGARIA: The general approach to the classification of the ecological status covers:
- Condition of biological quality elements;
- Concentrations of related physical and chemical elements for quality and concentration of specific pollutants;
- For differentiating excellent from good ecological status - hydromorphological elements for quality are used.
Common principles for determining the environmental status for different surface waters categories are regulated by Art. 135, item 9 of the Water Act. Assessment of biological quality elements is the guideline in determining ecological status and

physicochemical elements are supportive. For each type of water bodies, limit values have been developed for the 5 categories set out in Annexes 6 and 7 of Art. 12, par. 4 of Regulation H-4 for characterization of surface water.

HUNGARY: (1) Annual avarage concentration < AA-EQS and (2) Maximum concentration < MAC-EQS are met?

- If yes -> Good status
- if not met (only one of them): if it is possible HU use the following EQS-corrections:
    - bioavailabiltiy concentration of metals
    - natural background concentration of metals
    - local EQSs in mixing zones

Criteria of high confident:

- Do we analyse
    - all of PSs identified as being discharged into the body of water; and
    - all relevant PSs min. 12 times (1/month) during 1 year; and
    - all of other substances identified as being discharged in significant quantities into the body of water; and
    - all relevant other substances min. 4 times (each 3 months) during 1 year?
- And all LOQs ≤ 0.3 · EQSs?

MOLDOVA: The algorithm is described in GOVERNMENT DECISION Nr. 890 from 12.11.2013 for the approval of the “Regulation on Environmental Requirements for Surface Waters”.

SLOVENIA: Evaluation of the ecological status and definition of categories is done according to WFD and Decree on the status of surface waters.

UKRAINE: In the practice of ecological and geochemical research in the past of the USSR and today among the geochemists in Ukraine for assessing the pollution of rivers a methodology based on the intensity of the accumulation of chemical elements in bottom sediments and water is used (Yanin E.P., Technogenic geochemical associations in the bottom sediments of small rivers, M., IMGRE, 2002. 52c.).

In connection with the polyelemental nature of technogenic contamination of bottom sediments, to determine their total contamination by heavy metals, a method is used which involves the calculation of the total indicator (the sum of the coefficients of the concentration of anomalous chemical elements) of the accumulation of chemical elements (**Zc**) with a subsequent comparison of this indicator with the scale of contamination levels (Table 40).

In turn, the overall indicator of the accumulation of chemical elements, or the total pollution factor (Zc), was calculated by the formula:

$$Zc=\sum Ci/Cb-(n-1),$$

where:

Ci – the content of the chemical element in the sample;

Cb – background content of the chemical element;

n- number of chemical elements in the sample with abnormal content (Ci/Cb>2).

Table.40 - Tentative scale of estimation of river pollution by the intensity of accumulation of chemical elements in bottom sediments in Ukraine

Zc	**Level of technogenic pollution**	**Level of sanitary-toxicological danger**	**toxic elements concentration in river water**
< 10	Weak	Allowable	Most elements within the background
10-30	Medium	Moderate	Most elements exceed the background, and some reach the level of MPC
30-100	High	Dangerous	Some elements exceed the MPC level
100-300	Very high	Very dangerous	Most items exceed the MPC level
>300	Extremely high	Extremely dangerous	Most elements consistently exceed the MPC level

V.9. Difference between contamination and pollution in national legislations

The questions is intended in finding out how the national legislative framework defines the difference between contamination and pollution.

BULGARIA: "Environmental pollution" is the change in the properties as a result of occurrence and introduction of physical, chemical or biological factors from a natural or anthropogenic source in or outside the country, regardless if the national norms in force are exceeded.

"Environmental damage" is such an alteration of one or more components, resulting in a deterioration in the quality of life of humans, the deterioration of biodiversity or difficult restoration of natural ecosystems.

CROATIA: There is only contamination in the national legislation. Contamination is a direct or indirect introduction, as a result of human activity, of substances, vibration, heat or noise in the air, water or soil, which can be harmful to human health or the quality of the environment, can result in damage to property or impair or diminish value and other legitimate ways of using the environment.

SLOVENIA: The Environmental Protection Act gives the definition of pollution. Environmental pollution, directly or indirectly, of substances or energy into the air, water or land or causing waste, is a result of human activities that may harm the environment or human health or interfere with the right of ownership to damage or destroy proprietary or interfere with its the enjoyment of the right to use the environment.
Environmental pollution is the result of any intervention or interference in the environment, which is exclusively or simultaneously cause or causes environmental pollution, environmental risk, environmental damage or the use of natural resources.

SERBIA: Whilst the terms contamination and pollution are defined within the legislative framework, they are not defined clearly and precisely and the two terms seem to be used interchangeably.A clear difference between the two terms cannot be drawn from the definitions given within the legislative framework.

UKREINA: For emissions of enterprises into the atmosphere or discharges into the reservoir limits for concentrations of harmful substances are established. Concentration limits are calculated based on special programs that take into account possible scattering of the substance in the environment, which does not lead to excess of the MPC of harmful substances in the air or surface waters. These limits significantly (tenfold) exceed the background content of this substance in the environment

V.10. Relations between specific HSs and the contamination and pollution sources

This questions regards the way in which specific HSs relate with sources of contamination and pollution.

BULGARIA: If a water body is found to be of poor or very poor ecological status, or if concentrations of hazardous substances are exceeding the specified quality standards, possible sources of contamination are analyzed.

MOLDOVA: Specific HSs contamination are releted with specific pollution sources: agriculture, industry, polluted sites, dumps, etc. An analysis of the history of landuse, location of possible pollution sources etc. is made.
SLOVAKIA: If a water body is found to be of poor ecological status, or if concentrations of hazardous substances are exceeding the specified quality standards, possible sources of contamination are analyzed.

SLOVENIA: Specific HSs relate with sources of contamination and pollution, based on the data of emissions and research monitoring. In the case of exceeding a parameter at a given measuring point, the pollutants and their emissions are examined in their influence area. A research monitoring is then set up to determine the location of the source.

UKREINA: The geochemical association of pollution elements and their concentration in environmental objects (mainly in soils and bottom sediments) identifies the source of emissions (there are certain geochemical associations for emissions of major types of industrial enterprises in Ukraine and Russia). Such a technique is also not formally adopted at the State level.

V.11. Actions in case of contamination and pollution

The questions regards the description of actions in case of contamination and pollution.

BULGARIA: In case of damaged terrains recultivation projects according to the related Environmental laws are implemented, consisting in:
1. Analysis of the damaged area;
2. Detailed investigation including environmental risk assessment and human health risk assessment;
3. Design and implementation of projects for restoration of damaged areas;
4. Monitoring and maintenance of the functions of the restored areas.

GERMANY: According to WFD: as a results of operative monitoring, a program of measures is taken every 6 years.

SLOVENIA: The Slovenian Environment Agency (ARSO) checks the emission status, if necessary they carry out research monitoring and inform the inspection of the problem.

CROATIA: These actions are defined according to the situation. All information regarding actions is stated in Croatian legislative acts.
https://narodne-novine.nn.hr/clanci/sluzbeni/1999_08_82_1487.html
https://narodne-novine.nn.hr/clanci/sluzbeni/2008_10_113_3297.html
https://narodne-novine.nn.hr/clanci/sluzbeni/2008_12_145_3992.html
https://narodne-novine.nn.hr/clanci/sluzbeni/2014_04_44_813.html
https://narodne-novine.nn.hr/clanci/sluzbeni/2015_08_87_1727.html

MOLDOVA: The actions are information of local and central authorities, owners of studied site, population. The respective institutions calculate taxes for polluters, if those can be identified.

SERBIA: These specific actions to be undertaken are defined in relation to the case in question. Seeing that there is no clear distinction between contamination and pollution within the legislative framework, there is also no difference between the actions undertaken in case of contamination or pollution. The steps which are undertaken in cases of contamination/pollution are defined in the specific plans created by organizations in accordance with the requirements of national legislation. These plans include remediation programs and specific measures tailored to the industry in question.
The Draft Water Protection Plan contains a set of measures which can be undertaken to contain and remove certain pollutants from waters.
In cases where contaminated site has been identified, further research is conducted to establish the level of pollution. This is followed by the creation of remediation programs.

SLOVAKIA: If a water body is found to be of poor ecological status, or if concentrations of hazardous substances are exceeding the specified quality standards, possible sources of contamination are analysed.

ROMANIA: It is specified in the legislation that remedial measures will be taken, but the methodology is not described. Rehabilitation methods are in the scientific literature.

V.12. Representations of results, targeted audience and availability

The questions refers to the way the results are presented in the reports (e.g. using complex representation for scientific community or simple representation for target groups), if the reports include methodology, full results, QA/QC, models and if the results are public or can be obtained by request.

CROATIA: Results are presented in regular publications, which can be found on https://www.voda.hr7 and https://www.mzoip.hr/

SERBIA: Data is published in annual reports released by Environmental agency which contained the data in tabular form along with the analytical methodology. The reports are available to the public:
http://www.sepa.gov.rs/index.php?menu=5000&id=13&akcija=showExternal

HUNGARY: All public information is available via http://www.vizugy.hu/; inclouding last RBMPs: http://www.vizugy.hu/index.php?module=vizstrat&programelemid=149.

MOLDOVA: The mode of the presentation are different:

- Form of the approved test report for beneficiary of analysis;
- Scientific presentation;
- Simple presentation for population and civil society

Reports by specific projects financed from public sources are available free from internet. Test report of the private beneficiary is available only with the permission of the beneficiary. Scientific publication are available depending of publishing rules.

BOSNIA AND HERZEGOVINA (REPUBLIC OF SRSPKA): The results are presented as a simple representation and the final report includes methodology, full results, QA/QC and models. The results can be obtained by request.

SLOVAKIA: Data (groundwater and surface water) is published in annual reports released by the Slovak Hydrometeorological Institute which contained the result interpretation (data comparison with standards). The reports are available to the public: www.shmu.sk.
Presentation of the results of the stream sediment monitoring is difficult to interpret because of the complexity of the conditions of their chemical composition (weathering, sedimentation, migration of substances). The composition of the stream

sediment represents the natural features of the river basin area as well as the anthropogenic effect. Interpretation of results (SGIDS) takes into account the following approaches:

- application of statistical analysis (descriptive statistics, temporal variability);
- legislative approach (comparing the measured contents of the elements with specific limit concentrations);
- combined legislative and geostatistical approach (legislative assessment of the pollution parameters and the subsequent geostatistical treatment of the results in the map of the distribution of the contamination index).

SLOVENIA: The results of monitoring are available on the web site of the Slovenian Environment Agency (MOP-ARSO). http://www.arso.gov.si/en/
The original data (concentrations) are available in MS Excel files also on the web site: http://www.arso.gov.si/vode/podatki/arhiv/kakovost_arhiv2018.html

UKREINA: Results of ecological-geochemical studies in reports are provided for target groups. The report includes a methodology and full results. These results are open to everyone.

V.13. Space-time risk assessment methods

This question refers to the existence of a method for space-time risk assessment after determination of contamination and/or pollution.

BULGARIA: The assessment method for the change in concentrations of pollutants (HS) is the same for biota and sediment.
When obtaining at least 4 consecutive results as a trend assessment approach, the nonparametric method of Mann Kendall (Hirsch and Slack, 1984) is used. The method is suitable because it allows working with less than 6 results. There is no claim for a normal distribution of the results, which in any case cannot be assessed with such scarce data.
The nonparametric method of Mann Kendall is applicable when the pollutant values (x_i) are considered to follow the model:

$$x_i = f(t_i)+\varepsilon_i$$

where:
$f(t_i)$ - a continuous decreasing or increasing function of time and the residues
ε_i - are assumed to belong to the same distribution with an average value of zero.
Other scientific assessment methods are also applied.

CROATIA: The legislation incorporates the following directives:
https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31996L0082&from=HR
https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32003L0105&from=EN

MOLDOVA: The specific procedure of Environmental Risk Assessment is elaborated by our scientific group for polluted sites study on the base of the compilation of recommendations from different guides.

SLOVAKIA: Methodological Instruction of the Ministry of Environment of the Slovak Republic no. 549 / 98-2 for the risk assessment from contaminated sediments of streams and water reservoirs (A,B,C values)
Directive of the Ministry of Environment of the Slovak Republic no. 1 / 2015-7 to develop a risk analysis of the contaminated area (groundwater, rock environment, soils) (ID, IT values)

UKREINA: Methods of space-time risk assessment after the detection of pollution are used in the practice of ecological and geochemical research. Mainly, these are modelling and forecasting methods, but they are not perfect.

CONCLUSIONS

The quality standard values are fixed set in legislative acts.
Some legislations take into account the natural background concentrations of metals and their compounds, water hardness, pH, dissolved organic carbon for water, soil type (clayey, sandy, silty), the geological specifities of underground or surface waters.
Some legislations take into account the fact that sometimes,an metal is more toxic in some of its molecular compounds (especially in the aquatic environment) and besides “Total Metal Analysis“, analyzes of metal compounds are also made.
The legislation reflects the phenomenon of selective bioaccumulation and traceability of metals to a small extent (the accumulation of mercury in large fish or PAH in certain biota). Establishing a bioconcentration factor and association with a certain type of biota is not reflected in the general legislation.

Generally there is no difference in the national legislations between pollution and contamination.
In every country generally it is known that specific HSs are generated by specific industries.

The results of monitoring are generally open to public in all countries.
The legislation does not specify exact methods for remedying pollution because laws have a general character, but when developing an ecosystem guide, these details must be reflected. There are differences regarding the establishment of the ecological quality classes, although the classification criteria are the same.

3. CONCLUSIONS AND COUNTRY LEVEL EXECUTIVE SUMMARIES

AUSTRIA

I.LEGISLATIVE FRAMEWORK

Regarding surface and ground water quality, the Austrian Water Rights Act lists priority substances and priority hazardous substances. Alert and intervention threshold values are specified in the Quality Ordinance for the Chemistry of Groundwater and Surface Water. Normal values for natural metal and nutrient content in groundwater were established in a nation-wide study in 2018. Quality monitoring of surface and groundwater is performed according to the Ordinance for Water Monitoring.

Regarding top soils, Austrian standards specify normal values, alert and intervention threshold values for metal and non-metal trace elements.

Regarding river sediments, the Quality Ordinance for the Ecology of Surface Water specifies monitoring parameters (list of substances, sampling frequency) and permissible levels in sediments.

Regarding biota, the Quality Ordinance for the Ecology of Surface Water specifies monitoring parameters (list of substances, sampling frequency) and permissible levels in biota. An Austrian norm gives guidance on methods for sampling invertebrates in the hyporheic zone of rivers.

II PRACTICES, EXPERIENCES

Nation-wide studies have established chemical base line values for stream bed sediments (Geochemical Atlas of Austria, 2015), groundwater (GeoHint, 2018) and soil (2004). Monitoring sites and data are available online

- Water Information System Austria (WISA) for surface and groundwater as well as suspended river sediments
- Interactive Resources Information System (IRIS) for stream bed sediments
- Soil Information System (BORIS) for soils
- The institutions include
- Austrian Environment Agency (groundwater and surface water, stream bed and suspended sediments, biota) for regular national monitoring and on a project basis for specific studies

- Geological Survey of Austria (stream bed sediments, floodplain sediments, groundwater) on a project basis
- Austrian Institute of Technology (thermal / mineral water) on a project basis
- University of Natural Resources and Life Sciences, ViaDonau and Verbund Hydro Power AG (suspended sediments) on a project basis

III.INVENTORY OF SAMPLING METHODOLOGIES

Water sampling, transport and storage methods follow European (ISO) norms. The Austrian Environment Agency follows a fixed design for the location and number of sampling sites. Sampling frequency of water at risk is 4 times per year, surface water sampling frequency is 1 time per month. In-situ measurements include electrical conductivity, water temperature, pH, redox potential, oxygen content and discharge. Chemical analysis includes both organic and inorganic substances.

Stream bed sediment sampling is standardized by an Austrian norm and consists of one sampling site per 10 km^2 or at least on site per catchment (up to highest order). Mayor rivers are not sampled except downstream of emitters (settlements, industrial sites, treatment plants etc.). Only sites with active sediment are sampled, duplicate sampling is carried out for quality control for every 50^{th} sample. In-situ measurements include temperature, electrical conductivity, pH and redox potential. Two grain size fractions (< 180 µm and < 40 µm) are sampled. Chemical analysis includes 40 elements excluding organic substances.

Suspended sediment sampling is carried out according to Austrian legislation implementing the EU Water Framework Directive. Most sampling is carried out at river banks using bottles mounted on telescope poles, some samples are collected automatically at fixed stations by means of pumps. At one station, the multi-point method is used. Sampling frequency ranges between three days up to 6 hours (during floods). Samples are analyzed for sediment concentration, transport and load, as well as for grain size distribution. Chemical analyses are not performed.

IV.INVENTORY OF LABORATORY METHODOLOGIES

Hydrochemical analyses are standardized by Austrian / international norms. Laboratory requirements are prescribed by the Ordinance for the Qualification of Chemical Laboratories.

The Ordinance for Water Monitoring defines the parameters to be analysed in water samples (11 in-situ parameters, 17 chemical parameters, 9 dissolved metals, 12 volatile halogenated hydrocarbons, 77 pesticides). Analyses are performed by accredited Austrian laboratories.

Sediment sample analyses are performed by the Geological Survey of Austria using ICP-MS, ICS, XRF and XRD. 37 inorganic parameters are determined.

V .INVENTORY OF EVALUATION METHODS

Several units within the Austrian Environment Agency are responsible for, and involved in, the characterization of evaluation methods. Due to the complexity of this topic, section V was not covered in the questionnaire.

BOSNIA and HERZEGOVINA (Republic of Srpska)

I.LEGISLATIVE FRAMEWORK

In accordance with the Bosnia and Herzegovina (BiH) Constitution and the Constitutions of the Federation BiH (FBiH) and the Republika Srpska, as well as the Arbitration Decision for the Brcko District BiH (BD BiH), the competences for water management in BiH are at the level of the Entities and the BD BiH. The Water Laws of FBiH, Republika Srpska and Law on Water Protection of Brčko District of BiH provide a specific mandate to enable water resources to be managed at the entity levels and national interest.

According to the Law on Water of Republika Srpska, Public institution “Vode Srpske” Bijeljina is in charge of qualitative and quantitative water monitoring in Republika Srpska.

Having that in mind, at the beginning it was clarified that the presented Questionnaire for existing sampling, laboratory and evaluation methods concerns only Republika Srpska. It was prepared by Public institution “Vode Srpske” Bijeljina which is ASP of SIMONA Project Partner Croatian Geological Survey.

The legislative framework of Republika Srpska (laws, governmental orders, and emergency ordinances) which regulates the concentrations of dangerous substances posing a risk to the health of the population or aquatic life in surface and drinking waters was presented in the first part of the Questionnaire. Unfortunately, legislative framework on concentrations of dangerous substances in soil, river sediments, marine sediments, sewage, therapeutic sludge, air and biota, have not been established yet.

A list of dangerous (hazardous) substances (metals, non-metals, PAHs, PCBs and other parameters) was also presented, including concentration levels, their significance in waters in accordance with the existing legislative framework, as well as a list of analytical standards (national analytics and international e.g. USEPA, ASTM, etc.) recommended in documents for chemical, physical, microbiological analysis of samples in Republika Srpska (Regulation on water classification and categorization of water courses, Official Gazette of Republika Srpska 41/01).

It should be emphasized that the design of water sampling, transport, storage and sample preparation were performed in accordance with the corresponding set of ISO 5667 standards.

II PRACTICES, EXPERIENCES

In the second part of the Questionnaire, only one paper, titled „Considerations on reservoir sedimentation and heavy metals content within the Drenova reservoir“ and written by Radislav Tošić, Slavoljub Dragićević, Snežana Belanović, Ilija Brčeski and Novica Lovrić, was found to be appropriate.

Furthermore, sampling sites and current water quality monitoring stations of the Danube River Basin were presented on the map and listed in a table, and so were the existing water bodies.

III.INVENTORY OF SAMPLING METHODOLOGIES

The sampling design strategy was described in the third part, along with a list of parameters of water quality which are measured in-situ and a methodology for collecting samples. It was emphasized one more time that there are no biota and sediment monitoring (bottom, suspended or floodplain) in Republika Srpska.

IV.INVENTORY OF LABORATORY METHODOLOGIES

In part IV of the Questionnaire, were described analytical methods and equipment used for the hazardous substance analyzed in agreement with the corresponding matrix. Water samples are prepared in line with the requirements of the standard methods which are used for certain analysis and all applied methods are certified in line with ISO/IEC 17025. Additionaly, the limits of detection for each of the measured elements by AAS, GC, HPLC, and GCMS were stated.

Laboratories that are in charge of analyzing HS are requested to perform quality controls according to EN ISO/IEC 17025, and participate in proficiecy testing performed by the laboratory certified according to EN ISO/IEC 17043.

V .INVENTORY OF EVALUATION METHODS

In part V, the existing system for setting HSs threshold values in water was addressed. Fixed threshold values for HSs are set only for water samples in Regulation on water classification and categorization of water courses (Official Gazette of Republika Srpska 41/01) which is available at http://www.voders.org/propisi-i-obrasci/pravna-regulativa/.

The environmental quality objectives are based on measuring the total metal concentration.

Final annual reports include methodology, full results, QA/QC, models. Results can be obtained on request.

Several faults can be found within the current monitoring procedures:

- the lack of financial resources, inadequate laboratory capacities and lack of appropriate laboratory equipment and devices;
- the lack of regulations or criteria for including/excluding parameters from the monitoring programme for priority substances, which would allow more efficient use of budget resources;
- there are no systematic investigations on the concentration of priority substances in samples of biota and sediment.

BULGARIA

1. Responsible Institutions

- Ministry of Environment and Water (MOEW) through Water Management Directorate (https://www.moew.government.bg/en/)
- Executive Environment Agency (ExEA) (http://eea.government.bg/en)
- Basin Directorate Danube Region (BDDR) (http://www.bd-dunav.org/)

2. Legislative framework

Main European and National documents, applied in the development of the national program for the monitoring of sediment in surface waters:

- Water Framework Directive 2013/39/ЕС (2000/60/ЕО ,82/176/ЕИО, 83/513/ЕИО, 84/156/ЕИО, 84/491/ЕИО, 86/280/ЕИО, 2008/105/ЕО)
- Guidance document 19 – on surface water chemical monitoring under the WFD;
- Guidance document 25 – on chemical monitoring of sediment and biota under the WFD;
- National Water Law;
- National Regulation for characteristics of the surface waters;
- National Regulation for water monitoring;
- National Regulation for quality standards for priority substances and other hazardous substances in the environment ;
- National laws and regulation regarding the quality, monitoring, and maximum allowable concentrations of hazardous substances in soils;
- Project "Survey and assessment of surface water chemical status", 2014-2017, MOEW, "АКВА-ENV" Consortium;
- Soil Law;
- Regulation for the levels of maximum allowable concentration of harmful substances in soils;
- Regulation for soil monitoring.

3.Monitoring of Hazardous Substances in Surface Waters Sediments in Bulgaria

In Bulgaria surface waters sediments are monitored in accordance to the respective River Basin Management Plan (currently for the period 2016-2021). Only bottom river

sediments are sampled – from the shallower part of the river bed, during low water level. The frequency of sampling is once per 3 years. There are currently 35 monitoring station for surface waters sediments. Three of the stations are part of the Transnational Monitoring Network. Twenty Hazardous Substances are currently monitored – all part of the Priority Substance List of the European Water Framework Directive (Substances numbers - 2, 5, 6, 7, 12, 15, 16, 17, 18, 20, 21, 26, 28, 30, 34, 35, 36, 37, 43 and 44 from the List). Samples are also analyzed for TOC content and <0,063 mm grain fraction content.

For sampling, laboratory analysis, and evaluation the WFD recommendations along with its respective guidance documents are used. The following documents are used for the design of sampling, transport, storage, and sample preparation:

- БДС ISO 5667-12:2017 – Water quality. Sampling – bottom sediments from rivers, lakes, and estuary zones
- БДС EN ISO 15009:2016 – Soil quality. Gas-chromatographic determination of volatile aromatic HCs, naphtalene and volatile halogenated HCs
- БДС EN 16171:2016 – Sediments, processed bio-wastes, and soils. ICP-MS elements determinations.
- ISO 18287:2006 – Soil quality. Determination of polycyclic aromatic hydrocarbons (PAH). Gas chromatographic method with mass spectrometric detection (GC-MS);
- ISO 11277:2009 – Soil quality. Determination of particle size distribution in mineral soil material. Method by sieving and sedimentation;
- БДС ISO 14235:2002 – Soil quality. Organic carbon determination by sulphochromic oxidation;
- ILM 4006/2010 – Organochlorine pesticides and polychlorinated biphenyls determination in soils, sediments, and sludge.

In regards with the surface waters monitoring and biota monitoring, currently there are 243 sites for water monitoring (monitored 12 times per year), 195 river + 35 lake hydrobiological monitoring sites, and 50 biota monitoring sites (monitored once per year). The sampling, laboratory analysis, and the evaluation of the results are all conducted in accordance to the WFD, which is transposed in the National legislation.

4. Positive practices and problems in the current state of the HSs monitoring in surface water sediments in Bulgaria

The lack of experience in surface waters sediment sampling and monitoring, the lack of participation of national responsible or academic institutions in previous European projects with similar objectives, and some technical and laboratory constraints are the major difficulties in the monitoring process in Bulgaria.

On the positive side, national institutions such as MOEW and ExEA are willing to collaborate and interested in the Simona Project and its results. There is generally well-developed and continuously updating national monitoring regulation and the WFD is transposed in the National legislation which is a big step to standardizing the monitoring. Standardized documents (ISOs) are used for the sampling, transport, storage, and laboratory analysis. And national experts with long term experince in einvironmental monitoring are willing to participate in the trainings and workshops of the SIMONA project.

CROATIA

I.LEGISLATIVE FRAMEWORK

Croatia is in the process of setting up methodology for sediment sampling and analysis. There are no laws or any other official directives for sample media, except the obligation of implementation of EU Water Framework Directive in the next years.

In the national legislation threshold limit values are prescribed only for agricultural soil for metals: Cd, Cr, Cu, Hg, Ni, Pb and Zn; organic compounds: PAHs, PCB, insecticides based on chlorinated hydrocarbon and herbicides. The threshold limit values are not prescribed for sediment. There are prescribed threshold limit values for water: groundwater, surface water, nearshore water, lakes, rivers, drinking water and bathing water. Mostly are in use ISO standards for sampling sediment, soil, water and biota as well as for transport and storage. Recommended remedy measures associated with the concentration of the hazardous substances (HSs) are defined in Croatian legislative according to the situation. Croatia is also part of the International Commission for the Protection of the Danube River (ICPDR). Commission has a manual for accident warning system which also applies in Croatia.

II PRACTICES, EXPERIENCES

Croatia has experience in the national and international projects like: Basic Geochemical Map of Croatia (1998 – 2009), FOREGS Geochemical mapping of Europe (1998-2005), Monitoring of Drava alluvial sediments (2004 - 2008), Origin, fate and Transport modelling of Nitrate in the Varaždin Alluvial aquifer – TRANITAL (2017 - 2021), Geochemical Mapping of Agriculture and Grazing Land Soil in Europe (GEMAS) (2008 - 2014). We participate in significant scientific papers like: FOREGS Geochemical Mapping Field manual (1998), Geochemical Atlas of Europe-Part 1 (2005), Geochemical Atlas of Europe-Part 2 (2008), Chemistry of Europe's Agricultural Soils-Part A (2014), Chemistry of Europe's Agricultural Soils-Part B (2014), Geochemical Atlas of Croatia (2009).

Croatia did not implement sediment monitoring procedures, while water and biota monitoring are ongoing according to the guidelines of the Water Framework Directive 2000/60/EC.

III.INVENTORY OF SAMPLING METHODOLOGIES

Water and sediment sampling design strategy is according to the methodology requested by Water Framework Directive. Type(s) of sediment sampled are bottom and floodplain. No parameters of sediment quality/quantity are measured in situ. The methodology for collecting samples for laboratory measurements is conducted according to the parameters intended to analyze later on. Transport of the samples is done in refrigerators. Samples are not archive.

IV.INVENTORY OF LABORATORY METHODOLOGIES

The samples are prepared first mechanically; water – filtration; sediment – drying, sieving, homogenization and biota – homogenization, cryogen grinding. Organic matter content in water and sediment is not being determined. HSs measured in water: Cu, Zn, Cr, Cd, Ni, Pb and As and in sediment: Cu, Zn, Cr, Cd, Ni, Pb and As. ICP-MS method is used preferably to AAS, XRF and DC-arc-AES. XRD is not being performed. Radionuclide monitoring in water, sediment and biota, at country level, is performed by Institute for Medical Research and Occupational Health, Zagreb. The measured radionuclides 40K, 137Cs, 134Cs 232Th, 238U, 226Ra, 228Ra 210Pb, 235U. Detection limits depend on the time of analysis, media type and used instrument. The accuracy and precision of the analytical procedures calculated using certified reference material, sample duplicate, repeatability of measurements.

V. INVENTORY OF EVALUATION METHODS

Threshold values for inorganic compounds are set according to WFD, but due to specific geology, there is possibility that some of these values should be revised. Corrections for threshold values are not used (amount of quartz, organic matter etc.). The environmental quality objectives are based on measuring the total metal concentration. Croatian legislative framework does not define difference between contamination and pollution. There is only contamination. Actions in case of contamination are defined according to the situation. All information regarding actions are prescribed in Croatian legislative. The space-time risk assessment after determination of contamination is in Croatian legislation incorporated from following directives: 96/82/EC and 2003/105/EC.

HUNGARY

I.LEGISLATIVE FRAMEWORK

Hungary is implementated the EU Water Framework Directive, and adapted the CIS guidance documents to the national strategies. Hungary is part of the International Commission for the Protection of the Danube River (ICPDR), therefore the ICPDR guidances are also adapted to the national legislative framework and to the daily rutine. Mostly are in use ISO standards for sampling, for transport and storage as well as for laboratory analisys too.

HU has investigate monitoring programs for find the best monitoring sites for long-term biota and sediment monitoring. The surface water threshold limit values (EQSs) are not yet prescribed for sediment, just for water, biota.

III. INVENTORY OF SAMPLING METHODOLOGIES

Sampling design strategy is according to the methodology requested by Water Framework Directive. HU has 3 type of monitoring programs with different monitoring sites and diffenerent sampling frequencies (Surveillance monitoring program; Operative monitoring program; and Investigate monitoring program).

The methodology for collecting samples for laboratory measurements is conducted according to the parameters intended to analyze later on. Transport of the samples is done in refrigerators. Samples are partly archived.

V. INVENTORY OF EVALUATION METHODS

Surface water chemical status assessment: Art. 16 of the WFD sets out the strategy to prevent chemical pollution of Surface Waterbodies (SW). The chemical status assessment is used alongside the ecological status assessment to determine the overall quality of a waterbody. Environmental Quality Standards (EQSs) are tools used for assessing the chemical status of waterbodies. The EQS Directive (2008/105/EK and 2013/39/EU) established

- the maximum acceptable concentration (MAC-EQS) and/or
- annual average concentration (AA-EQS)

for 45 priority substances and 8 other pollutants which, if met, allows the chemical status of the waterbody to be described as ‘good’.

For Priority substances and for Priority hazardous substances two status classes are defined: (1) Good and (2) Bad. These classes are used for metals, but also metals have one more class (0) Bellow background, which is almost the same as excellent class of ecological status. In some cases, HU use added value AA-EQS, when the ABC (ambient background concentration) is known.

Evaluation procedure: Criteria of (1) Annual average concentration < AA-EQS and (2) Maximum concentration < MAC-EQS are met?

- If yes -> Good status

- if not met (only one of them): if it is possible HU use the following EQS-corrections:
  - bioavailability concentration of metals
  - natural background concentration of metals
  - local EQSs in mixing zones

Criteria of high confident:

- Do we analyse
  - all of PSs identified as being discharged into the body of water; and
  - all relevant PSs min. 12 times (1/month) during 1 year; and
  - all of other substances identified as being discharged in significant quantities into the body of water; and
  - all relevant other substances min. 4 times (each 3 months) during 1 year?
- And all LOQs ≤ 0.3 · EQSs?

HU has also different EQSs for different spatial scales:

- EU level – EQSgeneric (2013/39/EU): protect min. 90% of EU waterbodies
- National/regional level – EQSregional: protect min. 90% of the WBs in the region
- Local level – EQSlocal: protect one waterbody or one group of waterbodies

MOLDAVIA

I.LEGISLATIVE FRAMEWORK

The Moldavian Government Decissions refer to natural waters: environmental requirements for surface waters, groundwater quality requirements, monitoring of status of surface and groundwaters, and prescriptions for treatment and discharging of urban and rural waste waters.

National legislation defined the threshold concentration for metal and nonmetal trace elements in soil, river water and drinking water, as well as PAHs in soil and water, persistent organic pollutants and microbial parameters in water. Also maximum admissible level of organic substances and pesticides in soil were defined by national legislation.

Analytical standards for water and soil sample analyses are National analytical standards and some international standards. ISO and ASTM standards are used as guides and techniques for sampling, transport, storage, preparation for analyses of sediment, soil and water.

II PRACTICES, EXPERIENCES

In Moldova it was implemented the National System of Environmental Quality Monitoring (2013-2015). In the Lower Prut region the monitoring stations are

watching both the river and adjacent lake water bodies, by water and sediment sampling for HSs, POPs, PAHs and heavy metal analyses. The State Hydrogeological Service offers annual on-line reports for the environmental status of the state territory. A River Basin Management Plan is available. The Hydro-Meteorological Service of Moldova published Annual Reports regarding the soil status; the surface water status based on hydrochemical indices; the surface water quality status based on hydrobiological elements (2015). Moldova is a member of international projects for prevention of natural disasters and mitigation of environmental pollution in the Lower Danube Euroregion (2013-2015). It is also part of the Danube - Prut - Black Sea Management Plan of the European Union Water Initiative Plus for the Eastern Partnership. The Black Sea Crossborder Cooperation Network is underway for monitoring environmental toxicants and evaluation of impact on human health and prevention of public exposure (MONITOX, 2017-2020). In various international journals there were published papers regarding the management of water quality in Moldova, as well as studies on pesticides, PAHs, OCPs pollution sources for soils in the Lower Danube region. The national monitoring program in Republic of Moldova does not work now on a regular basis caused by government reforming and lack of available funds.

III.INVENTORY OF SAMPLING METHODOLOGIES

The study of surface water bodies is made both for water and sediment samples. VOCs were collected first, followed by Semi VOCs (PCBs, pesticide), oil and grease, and total petroleum hydrocarbons (TPHs), then other parameters: total metals, dissolved metals, microbiological samples, and inorganic nonmetals. Sample size varies in the range of 5 mL for total petroleum hydrocarbons in liquid wastes, 100 mL for total metals, and 1 L for trace organics such as pesticides.

Water quality parameters measured in situ are pH, Conductivity/TDS, Temperature, and Dissolved Oxygen. Devices utilized: Multifunctional analyzers (potentiometers) Multi 350i, Consort 600C. Glass containers are generally used for organic compounds, and plastic containers are used for metals. The preservation of samples to minimize physical, chemical, and/or biological changes includes refrigeration, addition of preserving chemicals, and utilization of proper sample container. Holding time before analysis varies between 6 hours and 6 months.

Sediments taken in consideration are of all types. Monitoring of sediments in important water bodies (wetlands, lakes, polluted sites etc.) are performed every year, and by particular projects or, after contamination events, according to planned remediation actions. Ekman dredge is used for soft sediments on deeper water sites. Soil sampling kit Burkle 5350-1005 are used to take deeper sediment or soil samples. The soil sampling equipment depends of the sampling depth and sampling plan for the study of polluted or non polluted sites.

Biota: Hydro-biological monitoring in Danube – Prut river basin is focused on 6 groups of hydro-biologic indicators for the Environmental risk assessment procedure and evaluation of the impact from polluted sites. No specific measurements are made in situ.

IV.INVENTORY OF LABORATORY METHODOLOGIES

Water, sediment and biological samples are treated according to the specific recommendations for analytical methods. SOPs were elaborated according to ISO 17025 in accredited laboratory “GEOLAB” in Moldavian Accreditation System. Soil and sediments are analyzed for organic matter by GOST 23740-2016 Methods. For AAS analysis Equipment AAnalyst800, Perkin Elmer Inc, equipped by Plame, THGA and Hydride Generation System (FIAS400). The analytical procedures for various elements are described in SOP elaborated in TL “GEOLAB”. For organic compounds (HSs) in water and sediments EPA reference methods are utilized in accredited laboratories.

V .INVENTORY OF EVALUATION METHODS

Threshold values for HSs were evaluated for different type of soil depending of granulometric and organic content. For corrections additional analyses are required, such as granulometry and organic content. The legislation determines classes (categories) of environment quality. Classes of water are determined in GOVERNMENT DECISION No. 890 from 12.11.2013 for the approval of the “Regulation on Environmental Requirements for Surface Waters”. In this document the algorithm for defining these categories is described. The specific procedure of Environmental Risk Assessment is elaborated by scientific teams studying polluted sites, by compilation of recommendations from different guides.

MONTENEGRO

The information on the state of environment of Montenegro with the Proposal of Measures is one of the basic documents in the field of environment and it is issued annually by the Agency for Nature and Environment Protection of Montenegro.

https://epa.org.me/informacije-o-stanju-zivotne-sredine/

https://epa.org.me/izvjestaj-o-stanju-zivotne-sredine-na-bazi-indikatora/

The monitoring program is implemented by the institutions selected in the tender procedure, except for the monitoring of the quality of air implemented by D.O.O. "Center for Ecotoxicological Testing of Montenegro", based on the Decree on the Confidence of a Part of the Work under the Competence of the Agency for the Protection of Nature and the Environment.

The Water Quality Monitoring (for rivers) Program is proposed by the Ministry of Agriculture and Rural Development, which, in accordance with the Law on Waters, is implemented by the Institute of Hydrometeorology and Seismology of Montenegro. Water quality water testing on water intakes is carried out according to the annual program (in accordance with the aforementioned Law on Waters), which is adopted by the state administration body in charge of health affairs, with the previously obtained opinion of the Ministry and state administration bodies responsible for environmental affairs. Within the framework of the **Geological Survey of Montenegro and the hydrogeology departments**, the decennial project implies the development of basic hydrogeological maps, as well as the participation in the preparation of reports and information on quantity, quality and protection of all **groundwater** in the area of Montenegro.

Expert staff of the Agency for the Protection of Nature and Environment implements a biodiversity monitoring program from 2013 in the area of Montenegro.

In Montenegro there is not a regulation for the maximum allowable concentration of pollutants in sediments. Also, there are no laws, regulations or any other official directives for sampling the sediments, except the obligation to implement EU WFD in the next years.

The project entitled "**Strengthening Capacity for Implementation of the Water Framework Directive in Montenegro**" started in 2017 and will last for 3 years. The project will cover the whole territory of Montenegro, with a division into two main river basins, i.e: the Danube River Basin with larger rivers: Piva, Tara, Ćehotina and Lim; and the Adriatic Basin with larger rivers: Zeta, Morača and Bojana. The main objective of this project is to enable the Ministry of Agriculture and Rural Development and other beneficiaries to prepare the groundwater for the implementation of the EU Water Framework Directive and all water related directives through the provision of an operational and efficient network for the monitoring and preparation of river management plans basins for the Adriatic and Danube basins. The project, among other things, has the task of improving the water monitoring system in accordance with the WFD. This includes revision of existing monitoring parameters, location monitoring, proposal for new locations for surface water and groundwater, as well as laboratory equipment for chemical and biological monitoring for surface waters, together with groundwater monitoring equipment and hydrological determination.

Harmonized monitoring of surface waters, in line with the EU Water Framework Directive, includes:

● Biological monitoring should cover five elements of biological quality: Fauna of benthic invertebrates, Phytoplankton, Phytobenthos, Macrophytes and Fish

● Monitoring of general physical-chemical parameters following biological monitoring: analysis of basic parameters of water quality such as pH value, temperature, oxygen level, alkalinity, salinity and nutrients;

● Monitoring of **hydromorphological elements** following biological monitoring: the quantity and dynamics of water flow, groundwater connection, river continuity, variation of river width and depth, ***structure and sediment of the bottom of the river***, structure of the coastal belt, etc.

● Chemical monitoring must include the analysis of 45 priority substances from the WFD as defined in the Environmental Quality Standards Directive (EQSD 2013/39/EU), taking into account Directive 2009/90/EC laying down technical specifications for chemical analysis and monitoring water status in order to determine the chemical status.

The project is in the phase of implementation, development of new ones and amendments to the existing legal acts, as well as the establishment of water monitoring according to the WFD.

The Montenegro doesn't has monitoring of river sediment, but the "**Geological Survey of Montenegro**" has a lot of experience (specially for sampling sediments in streams) across Projects ("Geochemical reconnaissance stream sediment survey and other geochemical investigations in northeasters Montenegro" in 1975 for the United Nations, "Research of mineral resources in Montenegro" and "Basic geochemical map of Montenegro", which was completed in 2019).

ROMANIA

I.LEGISLATIVE FRAMEWORK

I.1.The legislative framework includes national laws (some transposing European directives) on environmental quality and environment elements (natural and artificial surface waters, groundwater, waste water, air, soil and sediments)

The representative ones are:

- Order 184/1997 for approval of the Environment Balance Sheet Procedure;
- Order 756/1997 for the approval of the Regulation on the assessment of environmental pollution;
- Order no. 161 of 16/02/2006 for the approval of the Normative on the Classification of Surface Water Quality to establish the ecological status of the water bodies
- Law no. 311 of 28/06/2004 on the quality of drinking water

- Water Framework Directive (60/2000/EC), transposed into the national legislation by the Law 107/1996 with subsequent amendments;
- Directive 2008/105/EC and Directive 2009/90/EC, transposed into the national legislation by HG 1038/2010.

In the annexes to these laws are listed indicators (of chemical and biological quality) for determining the quality of water bodies, or classes of soil use.

According to 756/1997, there are 5 sets for quality parameters (one set of normal values, two sets for the alert threshold and two for the intervention threshold).

According to 161/2006, there is only one set of admissible values for river waters and one for sediments. This law provides also for biota regulations.

According to 311/2004, there is a single set of acceptable values for drinking water.

In addition, there is an impressive number of normative acts that have the role of diminishing pollution by limiting, prohibiting some polluting economic activities, limiting emissions and discharges into waters, or by means of remediation measures for waste waters..

I.2.The biological, physico-chemical parameters (nutrients and specific non-synthetic and synthetic pollutants) provided in the legislative documents are comparable to those stipulated in the European legislation and in Romania's questionnaire (Annex 11), the threshold values for the chemical parameters called "non-synthetic polluants" (metals) and "synthetic pollutants "(organic compounds) are listed for river waters, soils, drinking water and sediments.

I.3. Soil quality is established in accordance with the type of use and five sets of values are provided.

Quality assurance and classifications are in line with European legislation for surface and groundwater monitoring. Monitoring is carried out by "Apele Romane" (Romanian Waters), which publishes an annual report available to the public.

The status of a body of surface water (river, lake, canal, river sector, canal sector, transitional waters, part of coastal waters) is established by assessing both its ecological status and the chemical status.

"Ecological status" is an expression of the quality of the structure and functioning of aquatic ecosystems associated with surface water, classified in accordance with Annex V of WFD (60/2000/EC).

The assessment of the ecological status of surface water bodies classifies surface water bodies in five quality classes, namely: very good, good, moderate, poor and bad, with the appropriate color code (blue, green, yellow, orange and red).

The assessment of the ecological status of bodies of surface water is achieved through the integration of quality elements (biological, physico-chemical, specific pollutants).

The quality biological elements used to assess the ecological status of natural water bodies are phytoplankton, phytobenthos, macro-invertebrates and fish (for rivers). For natural lakes, quality biological parameters include phytoplankton, phytobenthos and macro-invertebrates, and for transitional and coastal waters phytoplankton and phytobenthos.

For each of the mentioned biological elements and water typology, evaluation indices have been established, with values characteristic of the five quality classes and guide values for the reference status. To the selected indices a weighting is assigned, according to their importance for the considered quality biological element, and a multi-metric index (ranging from 0 to 1) is calculated. The ecological status of the considered element quality is determined based on this index.

In the rivers, phytoplankton is sensitive to pressures such as nutrient ratio, organic pollution, general degradation, phytobenthos (represented by the diatome communities), and is affected by the following types of disturbing factors: eutrophication, organic pollution, hydromorphological degradation, general degradation (non specific pressures), alteration of shore habitat, etc. Being sensitive to several stressors, phytobenthos becomes important for assessing the ecological status of natural watercourses.

The main pressures on benthic macronutrient communities in natural water bodies (river water) are organic pollution and general degradation.

Quality physico-chemical elements include general parameters describing thermal conditions (water temperature), acidification status (pH, alkalinity), salinity conditions (conductivity), oxygen regime (dissolved oxygen in terms of concentration, CCO-Cr, CBO5), but also other two very important categories: nutrients (N, N-NO2, N-NO3, Ntotal, P-PO4, Ptotal) and specific pollutants: non-synthetic pollutants (Cu, Zn, As, Cr), and synthetic pollutants (xilens, PCBs, toluene, acenaphthen, phenol, detergents and total cyanides).

The methodology for assessing the ecological status of natural water bodies in the "rivers" category for general physico-chemical elements (support for biological elements) complies with the requirements of Directive 90/2009/EC transposed into national legislation in Romania by Government Decision (HG 1038/2010).

In the assessment of specific pollutants there are used the annual average of the concentration values for each non-synthetic indicator (concentration of the dissolved fraction in the water column, taking also in consideration the natural background) and synthetic indicator (organic substances).The ratios refer to the total concentration in the water column.

The methodology for assessing the ecological status of water bodies in the "natural lakes" category for physico-chemical elements (support for biological elements) respects (as in the case of rivers) the requirements of Directive 90/2009/EC transposed into national legislation by HG 1038/2010 and takes into consideration generic physico-chemical elements (as in the case of rivers), specific synthetic and non-synthetic pollutants. In the assessment of the general physico-chemical quality elements for natural lakes, the arithmetic mean for the March-October growth season was applied for all indicators.

As in the case of rivers, the assessment of specific non-synthetic pollutants (metals) refers to the concentration of the dissolved fraction in the water column, and the loading due to the natural background is also considered. For synthetic (organic) substances the ratios refer to the total concentration in water column.

Characteristic values for the three classes of potential for heavily modified and artificial water bodies (maximum, good and moderate) are established. Also, the guide values for the reference status characteristic of each typological category have been specified. The environmental potential has been determined based on these categories.

In the assessment of the ecological potential of heavily modified and artificial water bodies the same methodology as for the natural bodies was used, with the observation that there are different thresholds for the proposed indices.

For high quality physico-chemical elements, in the case of heavily modified or artificial water bodies of the "rivers" and "storage lakes" category, the same threshold sets as for natural water bodies apply.

In accordance with the provisions of the Water Framework Directive (60/2000/EC), transposed into national legislation by Law 107/1996, with subsequent ammendments, as well as Directive 2008/105/EC and Directive 2009/90/EC, transposed in the national legislation by HG 1038/2010, for the assessment of the chemical status of hazardous and priority hazardous substances, both synthetic (organic) and non-synthetic (metals) in surface waters (rivers, natural and artificial lakes) and the modified ones, the primary statistical parameters, both the annual average (arithmetic mean) and the maximum annual concentration shall be calculated/established for each monitored substance for which environmental

quality standards (EQS) are set. For these values, any exceedance of the quality standards for annual mean concentrations and/or quality standards for maximum permissible concentrations results in the water body being declared as being in bad chemical status.

According to the Water Framework Directive (WFD), "groundwater body" means a distinct volume of groundwater from an aquifer or several aquifers. The "aquifer" is referred to as a layer or multiple geological layers of rocks with sufficient porosity and permeability to allow either significant flow of groundwater or a significant extracted amount of underground water.

"Groundwater status" is an expression of its state of quantity and chemical status.

"Good groundwater chemical status" is the chemical status of the body of groundwater that meets all the conditions of Annex V of the WFD.

For the groundwater categories, 2 quality conditions are established, namely: good chemical status and poor chemical status.

The assessment of the chemical status of groundwater bodies is carried out in accordance with the requirements of the Water Framework Directive 2000/60/EC, Directive 2006/118/EC on the protection of groundwater against pollution and deterioration transposed into national legislation by HG 53/2009 and Order 137/2009 which sets threshold values for groundwater bodies.

I.4. Generally, legislative documents do not require the use of some sampling, transport or in-situ or laboratory sampling guides, but contain recommendations (e.g. metal analysis using ICP-MS or AAS for water in authorized laboratories in accordance with Order 161/2006). Another example of recommendation is the need for mechanical preparation of sediments for which the granulation under 63 micrometers is provided for the listing of the allowed threshold of pollutants in Order 161/2006 (granulometric method or preparation is not mandatory in the mentioned law).

In the questionnaire of Romania (Annex 11) there are listed the ISO guidelines used in the research projects or in the monitoring carried out by the authorities regarding the sampling, transportation, manipulation, preparation and analysis in situ and in the laboratory of waters, soils, sediments and biota.

I.5. List of chronic or acute toxicity tests and determination of bioaccumulation or persistence in biota were published in the Ministry Order OM no. 245/2005 and in OM no. 565/01.07.2005 for the approval of the Risk Assessment Methodology of List I and List II of Hazardous Substances/Priority Substances in the Aquatic Environment by Mathematical Modeling and the Methodology for Assessment of the Impact of

List I and II hazardous/priority substances on the aquatic environment through ecotoxicological tests - green algae, daphnia, fish.

The ecotoxicological properties of municipal waste and the resulting leachate are required in the Romanian legislation (although no methods are described) in the "Framework regulation of the sanitation service of the localities" from 09.03.2015 - CHAPTER II "Ensuring the sanitation service and operating conditions - SECTION 10a Administration of landfills and/or municipal waste disposal facilities, article 97, paragraph 3, letter f: ecotoxicological properties of waste and the resulting leachate".

(https://lege5.ro/Gratuit/gyydgnjsgy/sectiunea-a-10-a-administrarea-depozitelor-de-deseuri-si-sau-a-inst-regulament-capitolul-ii-asigurarea-serviciului-de-salubrizare-si-conditii-de-functionare?dp=g43demjuhe4ds

In research projects, for this purpose there are used information available in the literature.

II PRACTICES, EXPERIENCES

The Romanian questionnaire lists the national and international projects concerning the Danube Basin water survey, as well as the monitoring stations. From 5000 existing titles related to the Danube river and Delta (since 1960 to present), 137 are listed. There are public data on the current economic pollutants agents, type of activity and polluting chemicals.

III.INVENTORY OF SAMPLING METHODOLOGIES

The sampling (location, number of sampling stations,sampling frequency), transport and preservation of the sample in accordance with the analysis to be carried out, takes place according to the ISO guidelines listed in the questionnaire for water, soils, sediment and biota. Biota consists of phytoplankton, phytobenthos, macro-invertebrates and fish (for rivers). In the case of research projects there are additional relevant parameters that are taken into consideration, depending on the project purpose. The sampling technique and sampling devices are described in the questionnaire (Annex 11).

The Romanian Waters Administration (Apele Române) takes samples of waters (additional sediments and biota). All these samples determine the water quality. No biota and sediments are monitored for determining their quality. Except for some information regarding the thresholds of some polluting chemical substances (non synthetic and synthetic) specified in Order 161/2006, there is no guide on the quality of sediments. The research projects use information from the literature.

In situ analyzes include nutrients (ammonium, nitrate, nitrite, phosphorus), important in determining the quality of aquatic ecosystems which play an important role in the biodegradation of organic pollutants. These analyzes are carried out with

sensors dedicated to the nutrient, as well as portable UV-VIS-IR spectrophotometers (for example, Hach). In addition, temperature, conductivity, salinity, ph are analyzed.

IV.INVENTORY OF LABORATORY METHODOLOGIES

Non-synthetic chemical substances are analyzed by ICP-OES, ICP-MS, AAS (flame, graphite furnace, hydride generator, etc., as well as associated technologies) or by XRF when the detection limits are relevant.

ISO or EPA analytical standards are used and these contain information on preparation procedures in accordance with the matrix, sample type, and analyzed element (microwave acid digestion or other technologies). These standards are listed in the questionnaire. For sample preparation procedures, analytical standards are used. Verification of the quality of the analysis is done by using CRM substances, interlaboratory comparisons and calibration programs or by monitoring the accredited laboratories by the appropriate institutions.

Synthetic pollutants (organic compounds) are analyzed by combined gas chromatography-flame ionization detection (GC-FID), gas chromatography - mass spectrometry (GC-MS) and thin-layer chromatography-flame ionization detection (TLC-FID). Total hydrocarbons (TPHs) can be analyzed with an IR spectrophotometer. The list of available equipment is presented in the Romanian questionnaire, the list of accredited laboratories in the country and their portfolio is publicly available.

V .INVENTORY OF EVALUATION METHODS

The parameters for water, soil and sediment quality determination are set by legislation. For waters, biological and physico-chemical parameters (nutrients, non-synthetic and synthetic hazardous substances) have threshold values established according to the water body typology. The typology includes the geological background, and there can be several types of lithologies on a river course. So, especially for the chemical parameters of the non-synthetic pollutants, the geological background is taken into account. In particular, for groundwater, the aquifer includes the influence of the geological factor. The legislation includes also the analysis of non-synthetic hazardous substances both in atomic state, and in more dangerous forms (in ionic complexes). Especially in the case of sediments, the chemical element in valence states known to be harmful to aquatic life is analyzed. Bioaccumulation phenomena are included in some cases (e.g. Hg analysis in fish) or monitoring of organic compounds (synthetic hazardous substances) when water quality is determined. In the case of scientific projects, the information from the literature on bioaccumulation are additionally used.

SERBIA

I.LEGISLATIVE FRAMEWORK

Numerous regulations and rulebooks deals with the allowable values of polluting substances in surface and groundwaters and set limits for their achievement, also with the parameters of ecological and chemical status of surface waters and the parameters of chemical and quantitative status of groundwater. For soils, the regulations apply for maximum permissible values of polluting with harmful and dangerous substances and on systematic monitoring of soil quality, indicators for land degradation risk assessment and methodology for the development of remediation programs.

Five classes of threshold values for polutants are given in the regulation that prescribes ecological and chemical status parameters for surface waters. There are also threshold regulations for priority hazard substances in surface waters, and for dangerous and harmful materials in groundwater. Maximum allowed concentration of inorganic and of organic materials and permissible concentration of pesticides in drinking water are also regulated, as well as the radiological properties of drinking water.

Threshold limit values are given for the assessment of sediment quality and for pollutants in soil. Quality objectives of HSs in sediments are also reglemented.

Numerous international analytical standards were addopted, concerning biological parameters, physico-chemical parameters, microbiological parameters, priority substances, polluting substances.

The guides of techniques on the design of sampling, transport, storage, sample preparation of sediment, soil, and water are: SRPS ISO 5667-1:2008; SRPS ISO 5667-12:2005; EN ISO 5667-15:2013 ; ISO 11466 (for sediment); ISO 10381-1:2002; ISO 18400-101; ISO 10381-1; JUS ISO 11464:2004 (for soil); SRPS EN ISO 5667-1:1999; SRPS EN ISO 5667-3:2012; SRPS EN ISO 5667-6; SRPS EN 13946:2015; SRPS EN 27828:2009; SRPS EN ISO 5667-6 (for water).

Serbia is part of the International Commission for the Protection of the Danube River (ICPDR).

II PRACTICES, EXPERIENCES

Along the Danube River are in operation a number of ten water quality, supervisory and operational monitoring stations, and many quality monitoring stations along rivers in the Republic of Serbia.

Surface water quality monitoring is institutionally assigned to the Environmental Protection Agency (SEPA). Introducing the requirements of the EU Water Framework Directive into the monitoring program has not been completed yet.

National and European projects referring to geochemistry of waters, soil and sediments in the Republic of Serbia are: FOREGS Geochemical mapping of Europe (1998-2005); Sustainable management of sediment resources (SedNet) (2002-2004); Sava River Basin: Sustainable Use, Management and Protection of Resources (2004-2007); Geochemical Mapping of Agriculture and Grazing Land Soil in Europe (GEMAS) (2008-2014); Reinforcing S&T Capacities of Two Emerging Research Centers for Natural and Industrial Pollutant Materials in Serbia and Slovenia (RESTCA-TERCE-NIPMSS) (2008-2011); Operational monitoring of surface and groundwaters in the Republic of Serbia (2017-2019).

Among significant scientific papers, signed by Serbian scientists, are FOREGS Geochemical mapping of Europe (1998-2005); Sava River Basin: Sustainable Use, Management and Protection of Resources (2004-2007); Sediment quality and impact assessment of pollutants (2007); EuroGeoSurveys Geochemical mapping of agricultural and grazing land soil of Europe (GEMAS) - Field manual (2008); Sediment regime of the Danube River in Serbia (2013).

III.INVENTORY OF SAMPLING METHODOLOGIES

Serbia is involved in transposing the EU WFD Directive and its accompanying Guidance Documents which define some of the methodology which should be used for sampling purposes.

Water sampling strategy follows the Annual monitoring program, as well as the Regulation on limit values for polluting substances in surface and groundwaters. The Serbian Environmental Protection Agency take in consideration, for in situ determination, some water quality parameters regulated by SRPS H.Z1.106:1970, SRPS H. Z1.111:1987, SRPSEN ISO 9963-1:2007, UP 1.87 to 1.88/PC12. The devices utilized for in situ measurements of water are: the Portable Spectrophotometer Instrument DR/2800, Hach, and Secchi disk. The methodology for collecting samples follow SRPS ISO 5667-1:2008, SRPS ISO 5667-3:2007, SRPS ISO 5667-6-1997, SRPS ISO 5667-4-1997, SRPS ISO 6107-2:198, SRPS EN 13946:2008, SRPS EN 27828:2009, SRPS ISO 5667-1:2008.

Sediment sampling are in accordance with the requirements defined in the Guidance on the design of sampling programmes and sampling techniques (ISO 5667-1:2006).

Sampling devices utilized are VanVeen grab sampler/ Graifer/ Core sampler. Sampling methodology follow SRPS ISO 5667-1:2008, SRPS ISO 5667-3:2007, SRPS ISO 6107-2:2005.

Biota is not monitored by the Serbian Environmental Protection Agency within its Danube river monitoring program.

IV.INVENTORY OF LABORATORY METHODOLOGIES

For chemical analyses the equipment include ICP-MS, Perkin Elmer and FAAS, AAS-ETA, ICP-OES, GC/MSD Perkin Elmer.

A long list of HSs priority substances are taken in consideration. The values for the limits of detection are not available, so only the limits of quantification are listed.

Responsible institution for radionuclide monitoring in the environment, is the National Directorate for Radiation and Nuclear Safety and Security. Total β radioactivity is measured (Bq/l) following TRS 295:19891, ISO 9696:1992, ISO 9697:1992, ВДМ 02:19723 (for water), and ISO 18589-3:2011, MARLAP:2004, ВДМ 02:1972 (for sediment).

V .INVENTORY OF EVALUATION METHODS

Threshold values for inorganic compounds are set according to WFD, some of these values should be revised. Based on deviations from threshold values, 5 different water classes are known (based on which purposes the water can be used for), depending on the deviation from the limit values.

In Serbia a clear difference between contamination and pollution cannot be drawn from the definitions given within the legislative framework. In case of contamination and pollution the steps which are undertaken are defined in the specific plans created by organizations in accordance with the requirements of national legislation. These plans include remediation programs and specific measures tailored to the industry in question.

SLOVAKIA

I. LEGISLATIVE FRAMEWORK

The most significant legislation used in Slovakia that regulates the concentrations of dangerous substances posing a risk to environment in soils, waters and sediments, is as follows (use of legislation depends on the different project objectives):

- Directive of the Ministry of Environment of the Slovak Republic no. 4 / 1999-3 for the compilation and issue of a geochemical map of river sediments at a scale of 1:50 000
- Decision no. 531/1994 on maximum levels of harmful substances in soil
- Methodological Instruction of the Ministry of Environment of the Slovak Republic no. 549 / 98-2 for the risk assessment from contaminated sediments of streams and water reservoirs
- Directive of the Ministry of Environment of the Slovak Republic no. 1 / 2015-7 to develop a risk analysis of the contaminated area

- Act no. 188/2003 Coll. on the application of sludge and bottom sediments to soil
- Decree of the Ministry of Environment of the Slovak Republic no. 283/2001 on the implementation of certain provisions of the Act on Waste
- Act no. 255/2011 Coll., Amending Act no. 514/2008 Col. management of waste from the mining industry.

In Slovakia, the choice of the analytical method is primarily conditioned by the required output quality, the quantification limit and the financial point of view. From the most accessible methods, it is possible to mention the following:

- Atomic Absorption Spectrometry (AAS),
- Inductively Coupled Plasma – Atomic Emission Spectrometry (ICP - AES),
- Inductively Coupled Plasma – Mass Spectrometry (ICP - MS),
- X-ray Fluorescence Spectrometry (XRF).

More detailed identification of minerals in sediments is realized, for example, using electron microscopy (SEM, TEM) and electron microanalysis or X-ray powder diffraction analysis.

The mobility of the elements (mainly potentially toxic trace elements) is experimentally evaluated by several approaches. These are, in particular, extraction experiments in laboratory conditions that imitate the changing conditions in the environment and help predict the risk of element mobilization from solid sediment phases. In addition to extraction methods, colony or batch experiments are also used to evaluate element mobility.

The most relevant parameters of the extraction methods are the nature of the reagent (type of substance, power), extraction time (from several hours to the days), or temperature. In Slovakia we tested several one-step extraction methods and sequential extraction methods.

An important prerequisite for obtaining representative results is correct sampling, which is guided by professional procedures, methodologies, standards. The most important in Slovakia are (specifically for sediments) (www.sutn.sk , www.iso.org):

- STN EN ISO 5667-1: 2007 Water quality. Sampling. Part 1: Instructions proposals for sampling programs.
- STN EN ISO 5667-2: 2007 Water quality. Sampling. Part 2: Guidance on sampling techniques.
- STN EN ISO 5667-3: 2007 Water quality. Sampling. Part 3: Instructions for preservation and handling of samples.
- STN ISO 5667-12: 2001 Water quality. Sampling. Part 12: Guidance on sampling of bottom sediments.

- STN ISO 5667-15: 2002 Water quality. Sampling. Part 15: Guidance on preservation and handling of sludge and sediment samples.
- STN ISO 5667-16: 2000 Water quality. Sampling. Part 16: Guidance on biological sampling.

II. PRACTICES, EXPERIENCES

List of significant ongoing projects in Slovakia focused on surface water and sediments is as follows:

- Monitoring of river sediments within the Partial Monitoring System of geological factors (SGIDS)
- Monitoring the impact of the Gabčíkovo water works on the quality of surface waters and sediments (WaterWork Company, state enterprise, Bratislava)
- Monitoring of physicochemical and biological elements of water quality in the years 2016 – 2020 (SWME, s. e.)
- DanubeSediment „Danube Sediment Management - Restoration of the Sediment Balance in the Danube River“ (international)
- FramWat „Framework for improving water balance and nutrient mitigation by applying small water retention measures“ (international)
- Monitoring and assessment of water status –Phase III. (WRI)
- Significant scientific papers related to mainly sediments are as follows:
- Geochemical atlas of the Slovak republic, part VI. Stream sediments (Bodiš et al., 1999)
- Evaluation of the Waste Water Tanks in the Slovak Republic in relation to the changes in the retention volume and the possibilities of improvement of their ecological status I, part Evaluation of Environmental Properties of Sediments (VS Palcmanská Maša) (Čuban, 2018)
- Evaluation of environmental impacts of sedimentation of small water reservoirs and possibilities of their solution (Hucko, 2011)
- Influence of erosion processes in river basins on water quality in streams. Final report (Hucko, 2009)
- Analyzes of bottom sediments as required by the Ministry of Environment of the Slovak Republic no. 549 / 98-2. VÚVH Bratislava (Hucko, 2007)
- Assessment of the impact of sediment extraction on VD Hričov (Hucko, 2007)
- Influence of the quality of surface waters and river sediments with organic substances from point sources of pollution in selected areas (Hucko et al., 2004)
- Verification of the sediment management system from water reservoirs (Hucko et al., 2003)
- Monitoring of the quality of surface waters and sediments of streams, canals and dams influenced by the Gabčíkovo water work. Final report for the period until 31 December 2004 (Valúchová et al., 2005)

- Mobilization of selected potentially toxic trace elements from river and bottom sediments and assessment of the risks of their entry into the environment under different sediment management methods. Dissertation (Pažická, 2018)
- Monitoring of river sediments in Slovakia. Mineralia Slovaca, 44 (Kordík et al., 2012)
- Assessing the impact of environmental loads on groundwater and sediments in the Sereď area. Podzemná voda. Vol. 22, no. 2. (Kordík et al., 2016)
- Qualitative assessment of river sediments of selected Slovakia streams and rivers – toxic elements. Final report. (Bodiš et al., 2013).

III. INVENTORY OF SAMPLING METHODOLOGIES

Surface water

Slovakia (SGIDS) participated on the project „Geochemical Atlas of Europe“. A precised and detailed sampling strategy was established and “Foregs geochemical mapping field manual” was created (http://weppi.gtk.fi/publ/foregsatlas/index.php)

Running stream water was collected from the small, second order, drainage basin (< 100 km^2) at the same site as the active stream sediment.

Sediment

Geochemical mapping programme (SGIDS), notably at large regional scales, requires the selection of an optimum geological material to be sampled. The sampled material should not only have suitable geochemical properties but also should be available more or less throughout the mapped area. Another very important fact that should be borne in mind is that equal sampling procedures must be used throughout the sampling campaign and all over the sampled area. Each collected sample is stored in a separate polyethylene bag. Where it’s possible, 1.2 kg of the finest clay material were collected from at least three points over a distance of about 20 m along the stream.

UWITEC Core tube sampler (and its components) working on the gravity principle, using a telescopic rod and the possibility of driving straight into the sediment, is used by Water Research Institute for bottom sediments sampling.

Slovakia participated on the project „ Geochemical Atlas of Europe“. A precised and detailed sampling strategy was established and “Foregs geochemical mapping field manual” was created (stream sediments, floodplain sediments). Details can be found at:

http://weppi.gtk.fi/publ/foregsatlas/index.php

V. INVENTORY OF EVALUATION METHODS

Quality standards for priority substances and other specific pollutants are defined with Regulation of the Ministry of the Environment, Slovakia. They refer to surface water and groundwater, whereas for sediments there are no such standards. Median + 2MAD value is used, if statistical approach is possible to be used (for water bodies or groundwater bodies) - spatial data with high density, comparison with monitoring data is taken into consideration (arithmetic mean or maximum value of the concentrations measured at different times of the year). For water bodies with gap of data, analogue approach is used or scientific estimate. For groundwater, first we calculated background values for each GW body. Then the threshold value usually represents the concentration in the middle between standard value and background value.

The quality standard values are fixed for specific water management plan. After new data collection the values can be revised. We take into account the natural background concentrations of metals and their compounds, water hardness, pH, dissolved organic carbon and other water quality parameters. It means, we take into consideration drainage basin lithology.

If a water body is found to be of poor ecological status, or if concentrations of hazardous substances are exceeding the specified quality standards, possible sources of contamination are analysed.

Data (groundwater and surface water) is published in annual reports released by Slovak hydrometeorological institute which contained the resulted interpretation (data comparison with standards). The reports are available to the public: www.shmu.sk.

Presentation of the results of the stream sediment monitoring is difficult to interpret because of the complexity of the conditions of their chemical composition (weathering, sedimentation, migration of substances). The composition of the stream sediment represents the natural features of the river basin area, as well as the anthropogenic effect. Interpretation of results in SGIDS takes into account the following approaches:

- application of statistical analysis (descriptive statistics, temporal variability),
- legislative approach (comparing the measured contents of the elements with specific limit concentrations),
- combined legislative and geostatistical approach (legislative assessment of the pollution parameters and the subsequent geostatistical treatment of the results in the map of the distribution of the contamination index).

SLOVENIA

I.LEGISLATIVE FRAMEWORK

In Slovenia, monitoring of water, sediment and biota is carried out by Slovenian Environment Agency (ARSO) in accordance with EU Water Framework Directive (WFD) which sets out uniform principles for the monitoring and assessment of water status for all Member States of the European Union.

The area of monitoring the status of waters is regulated by the Rules on the monitoring of surface waters (Official Gazette of the Republic of Slovenia, 10/2009, 81/2011). The criteria and method of assessing the status of waters are determined by the Decree on the Status of Surface Waters (Official Gazette of the Republic of Slovenia, 14/2009, 98/2010, 96/2013, 24/2016). In areas with special requirements, the monitoring of water quality is determined by some additional regulations.

II PRACTICES, EXPERIENCES

Programs for monitoring are prepared by ARSO, which is also responsible for their implementation, data control and assessment. The program for the period 2016 - 2021 has been prepared in accordance with national and European legislations and in accordance with international conventions and interstate agreements with neighbouring countries and contains three types of monitoring: Surveillance, operational and investigative monitoring.

The network consists of measuring points which are defined as points on the individual river water body for sampling physico-chemical parameters, priority, preferably hazardous substances and special pollutants. In most cases in a single water body one measuring point is selected, and in some cases two measuring points. In order to monitor the impact of leakage from the municipal wastewater treatment plant on the status of water bodies, the existing measuring points were selected, but if they were not appropriate according to the expert assessment, new measuring points were found outside the mixing area.

For the general chemical status in Slovenia, sediments are monitored at most surveillance measuring points; In addition, they are also monitored at sites where pollution loads are detected (eg PCBs in Krupa, Lahinja, Kolpa). Sampling of sediments is carried out only for bottom sediments at 20 measuring points. Sampling for water quality is carried out at 125 monitoring points in the area of Danube River Basin. Slovenia is also involved in the Transnational Monitoring Network (TNMN) on the Danube tributaries, on the Sava and the Drava Rivers. These two locations are on the border profiles with Croatia, which are also included in the national program and in the bilateral monitoring with Croatia. The TNMN biological monitoring program is adapted to the requirements of the WFD.

III. INVENTORY OF SAMPLING METHODOLOGIES

Sediments are monitored due to trends every 3 years, in accordance with WFD, Decree on the status of surface waters and the Rules on the monitoring of surface waters, while water is monitored at least monthly and biota yearly.

Sampling and most of the analyses are performed by accredited (for sampling and most of the analyses) external laboratory, ARSO only carries out analyses of metals in water, which has accreditation for those analyses.

For sampling river water standards SIST ISO 5667-6 and ISO 5667-3 are used, while for sampling bottom sediments standards SIST ISO 5667-12 and ISO 5667-15 are used. For the chemical analysis of sediments, the wet sieved fraction < 63 µm is used.

IV.INVENTORY OF LABORATORY METHODOLOGIES

River water monitoring includes 45 priority substances of which 21 are priority hazardous substances (e.g. cadmium, mercury, endosulfan, nonylphenol, etc.). For these substances a uniform Environmental quality standards (EQS) are set up for water and organisms (fish) in accordance with WFD. EQS are generally fixed. Some metals also consider the natural background (Cd, B, Hg, Cu, Zn, Co, Sb) and bioaccumulation (Ni and Pb). For some elements such as Cd, Cu, Zn EQS vary depending on the water hardness.

The assessment of the chemical status of river water bodies represents the pollution of rivers with priority substances for which the uniform EQS are set up in WFD for EU territory. The chemical status of the surface water body is determined at a single measuring point based on the calculation of the annual average value of the parameters of the chemical status. The surface water body water has good chemical status if annual average value of each chemical status parameter calculated as the arithmetic mean of the concentrations measured at different time periods of the year does not exceed the EQS. The chemical status of surface water bodies can be good or bad.

V. INVENTORY OF EVALUATION METHODS

Evaluation of the ecological status and definition of categories is done according to WFD and Decree on the status of surface waters. There are 5 classes defined: excellent, good, moderate, bad, and very bad ecological status. The ecological status is evaluated by one module, ie. Modul of general degradation. The situation under this module is evaluated based on the Slovene index for the evaluation of the ecological status based of fish (SIFAIR). <<with SIFAIR the effects of changed hydromorphological characteristics of rivers, the presence of barriers, changed land use and other pollution could ne evaluated. The index is multimetric (composed of different biological metrics) and is typical for fish type. Additional data about the methodology for ecological status evaluation are available

http://www.mop.gov.si/fileadmin/mop.gov.si/pageuploads/podrocja/voda/ekolosko_stanje/metod_vredn_ekoloskega_st_vodotokov_rib.pdf.

The results of monitoring are available in the web site of Slovenian Environment Agency http://www.arso.gov.si/en/.

The original data (concentrations) are available in MS Excel files also in the web site: http://www.arso.gov.si/vode/podatki/arhiv/kakovost_arhiv2018.html.

The Environmental Agency of Slovenia suggests that uniform methodology for determining trends of sediments, which now is not yet prescribed, should be developed.

UKRAINE

I.LEGISLATIVE FRAMEWORK

In Ukraine existing normative documents are, in their majority, the analogues of those developed in the former USSR. Normative documents on the limits of concentration of hazardous substances in bottom sediments of rivers and lakes are lacking. Only maximum allowable concentrations for air of populated areas and for drinking water are available. Regulatory documents on the limits of the concentration of dangerous substances were imposed by Order of the Ministry of Health of Ukraine No. 201/1997; Order of the Ministry of Health of Ukraine No. 400/2010; DSTU 4808/2007 refering to Sources of centralized drinking water supply and for river water; SanPin 4266/87 – “Guidelines for assessing the degree of soil contamination by chemicals”. The values of the heavy metals concentration in soils of different parts of Ukraine were obtained during the implementation of the GEMAS program. There are reglemented the threshold concentrations for metal and non-metal trace elements in soils, river and drinking waters, radionuclides in river and drinking water, microbiological indicators in drinking waters (normal, alert and intervention thresholds). Only International analytical standards were utilized: USEPA-Method 245.1.; EPA Method 7473; U.S. EPA Method 245.5(CVAAS); ASTM D6722 - thermal decomposition; ASTM D6414-99 (wet digestion). There are missing information on the availability of nationally-based tests for chronic or acute toxicity and bioaccumulation. Guides of sampling to preparation techniques are: DSTU ISO 5667-12/2001 and DSTU ISO 5667-15/2007 for sediments; DSTU ISO 10381-1:2004 and DSTU ISO 11464:2007 for soil, DSTU ISO 5667-6:2009 and DSTU ISO 5667-3-2001 for water.

II PRACTICES, EXPERIENCES

The monitoring in Ukraine, along the Tisza River (of surface water levels, hydrochemical composition of surface water) is carried out by the Basin Department of the Water Resources of the Tisza River.

In 2000 it was created an automated information and measurement system for forecasting floods and for water resources management in the Tisza River Basin (AIVS-Tisza), in cooperation with Hungary. Eight hydrological stations in the Tisza basin were built and put into operation in the Transcarpathian region. Between 2014 and 2020, meetings of Hungary-Slovakia-Romania-Ukraine cross-border cooperation committees are sheduled. The last one was on 11/27/2018.

III. INVENTORY OF SAMPLING METHODOLOGIES

For water sampling planning is carried out according to DSTU ISO 5667-1: 2003, DSTU ISO 5667-2: 2003, DSTU ISO 5667-3: 2001, DSTU ISO 5667-4: 2003, DSTU ISO 5667-6: 2001. The in situ parameters of water have not yet been measured. Sample preservation follows DSTU ISO 5667-3/ 2001.

For sediment sampling, the locations were selected according to DSTU ISO 5667-12-2001. Sampling takes place during the summer low water period, once a year. For thicker muddy sediments (0.3 - 3.0 m) the Giller peat drill is used.

For laboratory measurements it was applied DSTU ISO 5667-12/2001.

Biota sampling are not taken into account.

IV.INVENTORY OF LABORATORY METHODOLOGIES

Analytical methods follow DSTU B V.2.1-19: 2009; DSTU CEN ISO / TS 17892: 2007; DSTU B V.2.7-232: 2010; DSTU B V.2.7-131: 2007; DSTU B V.2.7-71-98 norms.

Various laboratory methods for organic matter content determination are in accordance with MM (measurement methodology) 99-12-98 (petroleum products); DSTU ISO 7875-1: 2012, MM 105-12-98 (surface-active substances); DSTU ISO 6468-2002 (chlororganic substances); DSTU ISO 17993: 2008 (polycyclic aromatic hydrocarbons); MM 104-12-98 (phenols - Fluorate-02 analysers); DSTU ISO 5814-2003 (ISO 5814: 1990, IDT) (soluble oxygen); DSTU ISO 5815-1: 2009 (biochemical oxygen consumption).

No ICP-MS, ICP-AES systems. AAS systems in use are TERMOSIENIFICSOLAAR 6M (England). Chemical elements measuresd are: Hg (DSTU ISOO16772: 2005, ISO 16772: 2004, IDT) AAS Coldvapors; Pb, Cd, Cr, V, Mn, Co, Ni, Cu, Zn, Mo, Ti, As, etc. (DSTU ISO 15586: 2012; ISO 15586: 2003, IDT) - AAS-ETA; AAS-Flame, Spectrophotometric. Radionuclides detection in water utilized instruments and ISO norms as QUANTULUS-1200 spectrometer DSTU ISO 9696-2001 (H3, Rn222, Ra226,

Ra228, U, β, α); Radiometer of alpha-active gases РГА 03 (Альфа -1М). ISO 13165-1: 2013 (Ra226, U).

V. INVENTORY OF EVALUATION METHODS

There are methods for a complex environmental assessment, but they are not approved at state level. To estimate the level of contamination, the gross concentrations of elements in the bottom sediments are mainly used. Only the method of MPC for the toxic elements in food products is used. A tentative scale for estimation of pollution of rivers by the level of accumulation of technogenic chemical elements in bottom sediments was proposed following Yanin E.P., Technogenic geochemical associations in the bottom sediments of small rivers, M., IMGRE, 2002.

VI. LIST OF ANNEXES

Annex 1 – Empty Questionnaire

Annex 2 – Austria

Annex 3 – Bosnia and Herzegovina (Federation of Bosnia and Herzegovina)

Annex 4 - Bosnia and Herzegovina (Republic of Srpska)

Annex 5 – Bulgaria

Annex 6 – Germany

Annex 7 – Croatia

Annex 8 – Hungary

Annex 9 – Republic of Moldavia

Annex 10 – Montenegro

Annex 11 – Romania

Annex 12 – Serbia

Annex 13 – Slovakia

Annex 14 – Slovenia

Annex 15 – Ukraine

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