Interreg
Danube Transnational Programme
SIMONA

QUESTIONNAIRE FOR EXISTING SAMPLING, LABORATORY AND EVALUATION METHODS

0.0. State your institution and country.
0.1. State institution(s) from which you got data to fill this questionnaire.

I.LEGISLATIVE FRAMEWORK

I.1Enumeration of national or European legislation (laws, governmental orders, 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.
[PLEASE, SUPPORT YOUR ANSWERS WITH REFERENCES (NATIONAL LEGISLATIVE DOCUMENTS AND/OR WEB LINKS)]

Table

National / world legislation used in Slovakia that regulates the concentrations of dangerous substances posing a risk to the health of the population or aquatic life – focused on sediments

Use of legislation depends on the different objectives of the projects done by different institutions/authors

No	Title (in national language)	Title (in English)	Link	Country
1	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		SK
2	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		SK
3	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		SK
4	Smernica MŽP SR č. 1/2015-7 na vypracovanie analýzy rizika znečisteného územia	Directive of the Ministry of Environment of the Slovak Republic no. 1 / 2015-7 to develop a risk analysis of the contaminated area		SK
5		Canadian Standard „Provincial Sediment Quality Guidelines (PSQG)“		Canada
6		Canadian Standard „Canadian Sediment Quality Guideline for the Protection of Aquatic Life (CSQG)“		Canada
7		Dutch Standard „General Environmental Quality Standards“		The Netherland
8		„Australian and New Zealand Guidelines for Fresh and Marine Water Quality“		Australia
9		EPA “Consensus-Based Sediment Quality Guidelines”		USA
10	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	SK
11	Vyhláška MŽP SR č. 283/2001 o vykonaní niektorých ustanovení zákona o odpadoch	Decree of the Ministry of Environment of the Slovak Republic no. 283/2001 on the implementation of certain	www.slov-lex.sk	SK

No	Title (in national language)	Title (in English)	Link	Country
		provisions of the Act on Waste		
12	Rámcová smernica o odpadoch	Waste Framework Directive	https://eur-lex.europa.eu	SK/EU
13	Zákon č. 255/2011 Z.z., ktorým sa mení a dopĺňa zákon č. 514/2008 Z.z. o nakladaní s odpadom z ťažobného priemyslu	Act no. 255/2011 Coll., Amending Act no. 514/2008 Col. management of waste from the mining industry	www.slov-lex.sk	SK
14	Vyhláška Ministerstva životného prostredia SR č. 372/2015 z 28. júla 2015 o skládkovaní odpadov a dočasnom uskladnení kovovej ortuti	Decree of the Ministry of Environment of the Slovak Republic no. 372/2015 of 28 July 2015 on the landfill of waste and the temporary storage of metallic mercury	www.slov-lex.sk	SK
15	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		Czech Republic
16		EPA “Resource Conservation and Recovery Act”		USA

I.2 List 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

List of dangerous (hazardous) substances concentration levels used in Slovakia – focused on sediments

Use of concentration levels depends on the different objectives of the projects done by different institutions/authors

Indicator	Dutch General Environmental Quality Standards ($mg.kg^{-1}$)			Canadian CSQG ($mg.kg^{-1}$)		Canadian PSQG ($mg.kg^{-1}$)		Methodological instruction of the MoE No. 549/98-2 ($mg.kg^{-1}$)				Methodological instruction of the MoE No. 549/98-2 – water solution ($mg.l^{-1}$)		Decision No. 531/94-540 ($mg.kg^{-1}$)		
	M	**L**	**V**	**ISQG**	**PEL**	**LEL**	**SEL**	**TV**	**MPC**	**TVd**	**IV**	**TV**	**MPC**	**A**	**B**	**C**
Metals																
arsenic	85	85	150	5.9	17	6	33	29	55	55	55	0,8	25	29	30	50
barium								160	300	-	-	73	220	500	1000	2000
beryllium								1,1	1,2	-	-	0,02	0,2	3	20	30
cadmium	2	7.5	30	0.6	3	0.6	10	0,8	12	7,5	12	0,08	0,4	0,8	5	20
cobalt								9	19	-	-	0,2	2,8	20	50	300
chromium	480	480	10^3	37.3	90	26	110	100	380	380	380	0,2	8,7	130	250	800
copper	35	90	400	35.7	197	16	110	36	73	90	190	0,4	1,5	36	100	500
mercury	0.5	1.6	15	0.17	0.486	0.2	2,00	0,3	10	1,6	10	0,01	0,2	0,3	2	10
methyl mercury								0,3	1,4	-	-	0,01	0,02			
manganese						460	1100									
molybdenum								3	200	-	-	2,9	290	1	40	200
nickel	35	45	200			16	75	35	44	45	210	3,3	5,1	35	100	500
lead	530	530	10^3	35	91.3	31	250	85	530	530	530	0,2	11	85	150	600
antimony								3	15	-	-	0,3	6,5			
selenium								0,7	2,9	-	-	0,05	5,3	0,8	5	20
tin								-	-	-	-	0,2	18	20	50	300
thalium								1	2,6	-	-	0,04	1,6			
vanadium								42	56	-	-	0,8	4,3	120	200	500
zinc	480	10^3	2500	123	315	120	820	140	620	720	720	2,8	9,4	140	500	3000
Inorganic compounds																
P total						600	2000									
F total														500	1000	2000
S sulphide														2	20	200
Br total														20	50	300

Indicator	Dutch General Environmental Quality Standards (mg.kg^{-1})			Canadian CSQG (mg.kg^{-1})		Canadian PSQG (mg.kg^{-1})		Methodological instruction of the MoE No. 549/98-2 (mg.kg^{-1})				Methodological instruction of the MoE No. 549/98-2 – water solution (mg.l^{-1})		Decision No. 531/94-540 (mg.kg^{-1})		
	M	**L**	**V**	**ISQG**	**PEL**	**LEL**	**SEL**	**TV**	**MPC**	**TVd**	**IV**	**TV**	**MPC**	**A**	**B**	**C**
Polycyclic aromatic hydrocarbons (PAH)																
acenaphthene				0.00671	0.0889											
acenaphthylene				0.00578	0.128											
anthracene	0.05	0.8	3	0.0469	0.245			0,001	0,1	0,8	-	0,0007	0,07	1	10	100
benzo(a)pyrene	0.05	0.8	3	0.0319	0.782			0,003	0,3	0,8	-	0,0005	0,05	0,1	1	10
benzo(a)anthracene	0.05	0.8	3	0.0317	0.385			0,003	0,4	0,8	-	0,0001	0,01	1	5	50
benzo(a)fluoranthene														1	5	50
benzo(b)fluoranthene	0.2	0.8	3													
benzo(k)fluoranthene	0.2	0.8	3					0,02	2	0,8	-	0,0004	0,04			
benzo(ghi)perylene	0.05	0.8	3					0,08	8	0,8	-	0,0003	0,03	10	10	100
dibenz*(a,h)*anthracene				0.00622	0.135											
phenantrene	0.05	0.8	3	0.0419	0.515			0,005	0,5	0,8	-	0,003	0,3	1	10	100
fluoranthene	0.3	2	7	0.111	2.355			0,03	3	2	-	0,003	0,3	1	10	100
chrysene	0.05	0.8	3	0.0571	0.862			0,1	11	0,8	-	0,003	0,3	0,01	5	50
indeno(1,2,3-cd)pyrene	0.05	0.8	3					0,06	6	0,8	-	0,0004	0,04	1	5	50
naphthalene				0.0346	0.391			0,001	0,1	0,8	-	0,01	1,2	0,01	5	50
2-methylnaphthalene				0.0202	0.201											
Sum 10-PAH	0.6	4.5	17			2								-	20	200
Polychlorinated biphenyls																
PCB – congener 28	0.004	0.03	0.1					0,004	4	0,03	-	-	-	0,01	1	10
PCB – congener 52	0.004	0.03	0.1					0,004	4	0,03	-	-	-	0,01	1	10
PCB – congener 101	0.004	0.03	0.1					0,004	4	0,03	-	-	-	0,01	1	10
PCB – congener 118	0.004	0.03	0.1					0,004	4	0,03	-	-	-	0,01	1	10
PCB – congener 138	0.004	0.03	0.1					0,004	4	0,03	-	-	-	0,01	1	10
PCB – congener 153	0.004	0.03	0.1					0,004	4	0,03	-	-	-	0,01	1	10
PCB – congener 180	0.004	0.03	0.1					0,004	4	0,03	-	-	-	0,01	1	10
Σ PCB		0.2	0.4	0.0341	0.277	0.07		0,02	-	0,2	1	-	-	0,01	1	10
Mineral oils								50	1000	3000	5000	-	-	50	500	1000
EOX		7	20					0,1	-	7	-	-	-			

Indicator	Dutch General Environmental Quality Standards ($mg.kg^{-1}$)			Canadian CSQG ($mg.kg^{-1}$)		Canadian PSQG ($mg.kg^{-1}$)		Methodological instruction of the MoE No. 549/98-2 ($mg.kg^{-1}$)				Methodological instruction of the MoE No. 549/98-2 – water solution ($mg.l^{-1}$)		Decision No. 531/94-540 ($mg.kg^{-1}$)		
	M	**L**	**V**	**ISQG**	**PEL**	**LEL**	**SEL**	**TV**	**MPC**	**TVd**	**IV**	**TV**	**MPC**	**A**	**B**	**C**
Petroleum hydrocarbons	10^3	3.10^3	5.10^3					50	1000	-	-	-	-		-	
TOC						10^4	10^5									
pentachlorobenzene	0.3	0.3	0.5					1	100	0,3	-	3	300	0,01	1	10
hexachlorobenzene (HCB)	0.004	0.02	0.5			0.02		0,05	5	0,02	-	0,09	9	0,01	1	10
Σ chlorobenzenes without HCB								10	-	-	30	-	-	0,01	2	20
Organochlorinated pesticides																
aldrin								0,06	6	-	-	0,01	0,9			
dieldrin				0.00285	0.00667			5	450	-	-	0,1	12			
aldrin + dieldrin	0.04	0.04	0.5					-	-	40	-	-	-			
endrin	0.04	0.04	0.5	0.00267	0.0624			0,04	4	40	-	0,04	4		0,5	5
Σ -drins								5	-	-	4000	-	-			
DDT	0.01	0.02	0.5	0.00119	0.00477	0.007		0,09	9	-	-	0,004	0,4		0,5	5
DDD				0.00354	0.00851			0,02	2	-	-	0,004	0,4			
DDE				0.00142	0.00675			0,01	1	-	-	0,004	0,4			
Σ DDD, DDE, DDT								0,3	-	20	4000	-	-			
a-endosulfan								0,01	1	-	4	0,2	20			
a-endosulfan + sulphate	0.01	0.02	0.5					-	-	20	-	-	-			
a-HCH		0.02	0.5					3	290	20	-	33	3300		0,5	5
b-HCH		0.02	0.5					9	920	20	-	8	800		0,5	5
y-HCH (lindan)	0.001	0.02	0.5			0.003		0,05	230	20	-	9	910		0,5	5
Σ HCH								1	-	-	2	-	-			
heptachlor	0.02	0.02	0.5	0.0006	0.00274			0,7	68	-	4	0,005	0,5		0,5	5
heptachloro-epoxide	0.02	0.02	0.5					0,0002	0,02	-	4	0,005	0,5		5	50
chlorodane	0.02			0.0045	0.00887			0,03	3	4	4	0,02	2			
hexachlorbutadiene	0.02	0.02	0.5					2,5	-	20	-	-	-		5	50
Σ Pesticides		0.1	2.5					-	-	100	-	-	-			

Indicator	Dutch General Environmental Quality Standards (mg.kg^{-1})			Canadian CSQG (mg.kg^{-1})		Canadian PSQG (mg.kg^{-1})		Methodological instruction of the MoE No. 549/98-2 (mg.kg^{-1})				Methodological instruction of the MoE No. 549/98-2 – water solution (mg.l^{-1})		Decision No. 531/94-540 (mg.kg^{-1})		
	M	**L**	**V**	**ISQG**	**PEL**	**LEL**	**SEL**	**TV**	**MPC**	**TVd**	**IV**	**TV**	**MPC**	**A**	**B**	**C**
fluorene				0.0212	0.144			0.03	3						-	
pyrene				0.0530	0.875											
toxaphene				0.0001												
pentachlorophenol	0.02							2	300	5	5	40	4000	0.01	0.5	5
Σ chlorphenols								10			10			0.01	1	10
Organotin compounds																
Tetrabutyltin compounds								0.8	78	-	-	16	1600			
Tributyltin compounds								0.1	10	-	-	0.1	14			
Triphenyl-tin compounds								0.08	8	-	-	0.05	5			
Σ organotin compounds								1	-	-	2.5	-	-			
Aromatic compounds																
benzene														-	0.5	5
ethyl benzene														-	5	50
toluene														-	3	30
xylenes														-	5	50
phenols														-	1	10
Aromatic compounds Total														-	7	70

Explanation:
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 lev**e**l 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)

282/2010 Government of Slovak Republic regulation. setting threshold values and a list of bodies of groundwater

Threshold values for the pollutants and groundwater pollution indicators. in mg/l

A. Threshold values for groundwater bodies in quaternary sediments

	As	Cd	Pb	Hg	NH_4	clorides Cl^-	SO_4^{2-}	Na	F	Fe	Mn	Cr total	Cu	Se
MIN value	0.00525	0.0016	0.0055	0.00055	0.255	51.35	135.35	103.45	0.755	0.125	0.0265	0.0255	0.5005	0.0055
MAX value	0.0075	0.002	0.01	0.00075	0.5	72.35	171.05	119.8	1	0.2	0.05	0.027	0.5045	0.006

B. Threshold values for groundwater bodies in pre-quaternary rocks

	As	Cd	Pb	Hg	NH_4	Cl^-	SO_4^{2-}	Na	F	Fe	Mn	Cr total	Cu	Se
MIN value	0.00525	0.001525	0.0055	0.000505	0.26	50.7	129.75	50.45	0.75	0.105	0.0265	0.02515	0.5002	0.0055
MAX value	0.01	0.0025	0.009	0.0007	0.35	102	216.5	79.05	0.95	0.135	0.2	0.026	0.5035	0.006

C. Threshold values for synthetically produced pollutants

Synthetically produced substance	**Threshold value (µg/l)**
trichlorethylene	5.5
tetrachlorethylene	5.5
benzene	0.75
dichlorobenzene	187.5
1.2-dichloroethane	1.65
monochlorobenzene	6.25
Polycyclic aromatic hydrocarbons	0.0625
Benzo / a / pyrene	0.00625
styrene	12.5
carbon tetrachloride	1.1
Toluene	437.5
Xylens	312.5

Overview of legislation limiting the management of sediments on the basis of the limit values for selected elements in sediments (sediment leachates)

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
Cu	1000	100	5	10	-
Zn	2500	300	5	20	-

Decree No. 247/2017 Coll. Decree of the Ministry of Health of the Slovak Republic laying down details of drinking water quality, drinking water quality control, monitoring and risk management of drinking water supply

Microbiological and biological indicators			
Indicator	**Symbol**	**Limit value**	**Unit**
Esterechia coli	EC	0	CFU/ 1000 ml CFU/ 10 ml CFU/ 250 ml
Coliform bacteria	KB	0	CFU/ 1000ml CFU/ 10 ml CFU/ 250 ml
Enterococci	EK	0	CFU/ 1000ml CFU/ 10 ml CFU/ 250 ml
Pseudomonas aeruginosa	PA	0	CFU/ 250 ml
Cultured microorganisms T = 22 °C	KM22	200 500 100	CFU/ ml CFU/ ml CFU/ ml
Cultured microorganisms T = 36 °C	KM36	50 100 20	CFU/ ml CFU/ ml CFU/ ml
Living	ŽO	0	individual/ ml

Microbiological and biological indicators			
Indicator	**Symbol**	**Limit value**	**Unit**
microorganisms		0	individual/ ml
Fibrous bacteria	VB	0 0	individual/ ml individual/ ml
Micromycotes determined microscopically	MM	0 0	individual/ ml individual/ ml
Dead microorganisms	MO	30 30	individual/ ml individual/ ml
Iron and Manganese bacteria	ŽMB	10 10	field coverage in %
Abioseston	AB	10 10	field coverage in %
Clostridium perfringens	CP	0 0	CFU/ 100 ml CFU/ 100 ml

Indicator	**Symbol**	**Limit value**	**Unit**
Inorganic indicators			
Antimony	Sb	5.0	$\mu g.l^{-1}$
Arsenic	As	10.0	$\mu g.l^{-1}$
Boron	B	1.0	$mg.l^{-1}$
Nitrates	NO_3^-	50.0	$mg.l^{-1}$
Nitrites	NO_2^-	0.50	$mg.l^{-1}$
Fluoride	F^-	1.50	$mg.l^{-1}$
Chrome	Cr	50.0	$\mu g.l^{-1}$
Cadmium	Cd	5.0	$\mu g.l^{-1}$
Cyanides	CN^-	50.0	$\mu g.l^{-1}$
Copper	Cu	2.0	$mg.l^{-1}$
Nickel	Ni	20.0	$\mu g.l^{-1}$
Lead	Pb	10.0	$\mu g.l^{-1}$
Mercury	Hg	1.0	$\mu g.l^{-1}$
Selenium	Se	10.0	$\mu g.l^{-1}$
Organic indicators			
Acrylamide	-	0.10	$\mu g.l^{-1}$
Benzene	-	1.0	$\mu g.l^{-1}$
Monochlorbenzene	MCB	10.0	$\mu g.l^{-1}$
Dichlorbenzene	DCB	0.30	$\mu g.l^{-1}$
1,2-dichloroethane	DCA	3.0	$\mu g.l^{-1}$
Total organic carbon	TOC	3.0	$mg.l^{-1}$
Pesticides	PL	0.10	$\mu g.l^{-1}$
Pesticides total	PLs	0.50	$\mu g.l^{-1}$
Polycyclic aromatic hydrocarbons	PAU	0.10	$\mu g.l^{-1}$
Benzo(a)pyren	B(a)P	0.010	$\mu g.l^{-1}$
Epichlorhydrin	-	0.10	$\mu g.l^{-1}$
Tetrachlorethene and trichlorethene	PCE + TCE	10.0	$\mu g.l^{-1}$

Indicator	Symbol	Limit value	Unit
Vinyl chloride	-	0.50	$\mu g.l^{-1}$
Microcystine LR	LR	1.0	$\mu g.l^{-1}$
Indicators that may adversely affect the properties of drinking water			
Ammonium ions	NH_4^+	0.50	$mg.l^{-1}$
Chloride	Cl^-	250	$mg.l^{-1}$
Manganese	Mn	50.0	$\mu g.l^{-1}$
Sulphates	SO_4^{2-}	250	$mg.l^{-1}$
Iron	Fe	0.20	$mg.l^{-1}$
Sodium	Na	200	$mg.l^{-1}$
Chemical oxygen demand	$CHSK_{Mn}$	3.0	$mg.l^{-1}$
	pH	6.5 – 9.5	
Conductivity	EK	125.0	mS/ m T = 20 °C
colour, taste, turbidity, odor, temperature			
Indicators investigated for disinfection and chemical treatment of drinking water			
Free chlorine	Cl_2	0.30	$mg.l^{-1}$
Bromate	BrO_3^-	10.0	$\mu g.l^{-1}$
2,4-dichlorphenol	DCP	2.0	$\mu g.l^{-1}$
2,4,6-trichlorphenol	TCP	10.0	$\mu g.l^{-1}$
Chlorinedioxide	ClO_2	0.20	$mg.l^{-1}$
Chlorite	ClO_2^-	0.20	$mg.l^{-1}$
Chlorate	ClO_3^-	0.20	$mg.l^{-1}$
Ozone	O_3	50.0	$\mu g.l^{-1}$
Silver	Ag	50.0	$\mu g.l^{-1}$
Aluminium	Al	0.20	$mg.l^{-1}$
Trihalomethanes	THMs	0.10	$mg.l^{-1}$
Haloacetic acid	HAAs	60.0	$\mu g.l^{-1}$
Substances whose presence in drinking water is desirable			
Magnesium	Mg	10.0 – 30.0 120	$mg.l^{-1}$ $mg.l^{-1}$
Calcium	Ca	> 30	$mg.l^{-1}$
	Ca + Mg	1.1 – 5.0	$mmol.l^{-1}$

Government Regulation no. 269/2010 Coll. Government Regulation of the Slovak Republic laying down requirements for achieving good status of waters
Surface water

Indicator	Symbol	Unit	Value
WATER QUALITY INDICATORS			
Soluble oxygen	O_2	$mg.l^{-1}$	more than 5
Biological oxygen demand (suppressed nitrification)	BSK_5	$mg.l^{-1}$	7
Chemical oxygen demand	$CHSK_{Mn}$	$mg.l^{-1}$	35
Total organic carbon	TOC	$mg.l^{-1}$	11
Sulfane a sulphides	S^{2-}	$mg.l^{-1}$	0.02

Indicator	Symbol	Unit	Value
	pH		6 – 8.5
Temperature	t	°C	< 26
Dissolved substances, dried at 105 °C	PL_{102}	$mg.l^{-1}$	900
Dissolved substances, annealed at 550 °C	RL_{550}	$mg.l^{-1}$	640
Iron- total	Fe	$mg.l^{-1}$	2
Conductivity	EK	$mS.m^{-1}$	110
Manganese- total	Mn	$mg.l^{-1}$	0.3
Calcium	Ca	$mg.l^{-1}$	100
Magnesium	Mg	$mg.l^{-1}$	200
Chlorides	Cl^-	$mg.l^{-1}$	200
Sulphates	SO_4^{2-}	$mg.l^{-1}$	250
Sodium	Na	$mg.l^{-1}$	100
Fluoride	F^-	$mg.l^{-1}$	1.5
Ammonium nitrogen	$N\text{-}NH_4$	$mg.l^{-1}$	1.0
Nitrite nitrogen	$N\text{-}NO_2$	$mg.l^{-1}$	0.02
Nitric nitrogen	$N\text{-}NO_3$	$mg.l^{-1}$	5.0
Free ammonia	NH_3	$mg.l^{-1}$	0.3
Organic nitrogen	N_{org}	$mg.l^{-1}$	2.5
Nitrogen- total	N_{tot}	$mg.l^{-1}$	9
Phosphor- total	P_{tot}	$mg.l^{-1}$	0.4
phenolic index	FN	$mg.l^{-1}$	0.02
Surface active substances- anionic	PAL-A	$mg.l^{-1}$	1.0
Absorbable organically bound halogens	AOX	$\mu g.l^{-1}$	20
Non-polar extractable substances	NEL	$mg.l^{-1}$	0.1
Chrome (VI)	Cr^{6+}	$\mu g.l^{-1}$	9
Aluminium	Al	$\mu g.l^{-1}$	200
Cobalt	Co	$\mu g.l^{-1}$	50
Selenium	Se	$\mu g.l^{-1}$	20
Silver	Ag	$\mu g.l^{-1}$	5
Vanadium	V	$\mu g.l^{-1}$	20
Chlorobenzene	CB	$\mu g.l^{-1}$	10
dichlorobenzene	DCB	$\mu g.l^{-1}$	1.0
nitrobenzene	NB	$\mu g.l^{-1}$	10
1,2-cis-dichlorethene	1,2-DCE	$\mu g.l^{-1}$	0.4
2-monochlorphenol	CP	$\mu g.l^{-1}$	0.1
2,4-dichlorphenol	DCP	$\mu g.l^{-1}$	0.1
2,4,6-trichlorphenol	TCP	$\mu g.l^{-1}$	0.1

Indicator	Symbol	Unit	Annual average		Max. admissible concentration	
WATER QUALITY INDICATORS - non-synthetic substances						
Arsenic	As	µg.l^{-1}	7.5		-	
Chrome- total	Cr_{tot}	µg.l^{-1}	9		-	
Cadmium	Cd	µg.l^{-1}	1., 2. class	0.08	1., 2. class	0.45
			3. class	0.09	3. class	0.60
			4. class	0.15	4. class	0.90
			5. class	0.25	5. class	1.50
Copper	Cu	µg.l^{-1}	1., 2. class	1.1	-	
			3. class	4.8		
			4., 5. class	8.8		
Nickel	Ni	µg.l^{-1}	20		-	
Lead	Pb	µg.l^{-1}	7.2		-	
Mercury	Hg	µg.l^{-1}	0.05		0.07	
Zinc	Zn	µg.l^{-1}	1., 2. class	7.8	-	
			3. class	35.1		
			4., 5. class	52.0		

NOTE: 1.class: concentration of $CaCO_3$ < 40 mg.l^{-1}, 2.class: concentration of $CaCO_3$ = 40 - < 50 mg.l^{-1}, 3.class: concentration of $CaCO_3$ = 50 - < 100 mg.l^{-1}, 4.class: concentration of $CaCO_3$ = 100 - < 200 mg.l^{-1}, 5.class: concentration of $CaCO_3$ >200 mg.l^{-1}

Indicators	Symbol	Unit	Annual average	Max. admissible concentration
WATER QUALITY INDICATORS - synthetic substances				
Alachlor	-	µg.l^{-1}	0.3	0.7
Anthracene	-	µg.l^{-1}	0.1	0.4
atrazine	-	µg.l^{-1}	0.6	2.0
Benzene	-	µg.l^{-1}	10	50
Brominated diphenyl ether	-	µg.l^{-1}	0.0005	-
Chloralkanes $C_{10} – C_{13}$	-	µg.l^{-1}	0.4	1.4
Chlorfenvinfor	-	µg.l^{-1}	0.1	0.3
Chlorpyrifos	-	µg.l^{-1}	0.03	0.1
Cyclodine pesticides	-	µg.l^{-1}	∑=0.01	-
DDT- total	DDT	µg.l^{-1}	∑=0.025	-
para, para-DDT	p,p DDT	µg.l^{-1}	0.01	-
1,2- dichlorethane	EDC	µg.l^{-1}	10	-
Dichlormethane	DCM	µg.l^{-1}	20	-
bis(2-ethylhexyl)-phthalate	DEHP	µg.l^{-1}	1.3	-
Diuron	-	µg.l^{-1}	0.2	1.8
Endosulfan	-	µg.l^{-1}	0.005	0.01

Indicators	**Symbol**	**Unit**	**Annual average**	**Max. admissible concentration**
Fluoralithene	FLU	$\mu g.l^{-1}$	0.1	1.0
Hexachlorbenzene	HCB	$\mu g.l^{-1}$	0.01	0.05
Hexachlorbutadiene	HCBD	$\mu g.l^{-1}$	0.1	0.6
Hexachlorcyclohexane	HCH	$\mu g.l^{-1}$	0.02	0.04
Isoproturon	-	$\mu g.l^{-1}$	0.3	1.0
Naphthaalene	-	$\mu g.l^{-1}$	2.4	-
Nonylphenol	nonylfenol	$\mu g.l^{-1}$	0.3	2.0
Oktylphenol	oktylfenol	$\mu g.l^{-1}$	0.1	-
Pentachlorbenzene	-	$\mu g.l^{-1}$	0.007	-
Pentachlorphenol	PCP	$\mu g.l^{-1}$	0.4	1.0
Benzo(a)pyrene	B(a)P	$\mu g.l^{-1}$	0.05	0.1
Benzo(b)fluoranthene	B(b)F	$\mu g.l^{-1}$	$\sum$=0.03	-
Benzo(k)fluoranthene	B(k)F			
Benzo(g,h,i)perylene	perylen	$\mu g.l^{-1}$	$\sum$=0.002	-
indeno(1,2,3-ch)pyrene	indenopyren			
simazine	SIM	$\mu g.l^{-1}$	1.0	4.0
Tetrachlorethylene	PCE	$\mu g.l^{-1}$	10	-
Tetrachlormethane	TCM	$\mu g.l^{-1}$	12	-
Trichlorethylene	TCE	$\mu g.l^{-1}$	10	-
Tributylcin compounds	TBT	$\mu g.l^{-1}$	0.0002	0.0015
Trichlorbenzene	TCB	$\mu g.l^{-1}$	0.4	-
Trichlormethane	$CHCl_3$	$\mu g.l^{-1}$	2.5	-
Trifluralin	-	$\mu g.l^{-1}$	0.03	-
Aniline	-	$\mu g.l^{-1}$	1.5	-
Benzensulfonamide	-	$\mu g.l^{-1}$	100	-
Benzthiazole	-	$\mu g.l^{-1}$	2.0	-
Biphenyl	-	$\mu g.l^{-1}$	1.0	3.6
Bisphenol A	BPA	$\mu g.l^{-1}$	10	460
Clopyralid	-	$\mu g.l^{-1}$	70	300
Desmedipham	-	$\mu g.l^{-1}$	1.0	15
Dibutyl phthalate	DBP	$\mu g.l^{-1}$	10	48
Diphenylamine	-	$\mu g.l^{-1}$	1.6	31
Ethofumesate	-	$\mu g.l^{-1}$	6.4	50
phenanthrene	-	$\mu g.l^{-1}$	0.38	2
Formaldehyde	-	$\mu g.l^{-1}$	5.0	50
Glyphosate	-	$\mu g.l^{-1}$	15	-
MCPA	MCPA	$\mu g.l^{-1}$	1.6	15
Cyanides- total	CN_{celk}	$\mu g.l^{-1}$	5	-
4-metyl-2,6-di-terc butylphenol	-	$\mu g.l^{-1}$	1.4	17
PCB	PCB	$\mu g.l^{-1}$	0.01	-
Pendimethalin	-	$\mu g.l^{-1}$	0.3	2
1,1,2-trichlorethane	-	$\mu g.l^{-1}$	300	-

Indicators	Symbol	Unit	Annual average	Max. admissible concentration
Toluene	-	µg.l^{-1}	100	-
Vinylbenzene	styrén	µg.l^{-1}	0.63	60
Xylenes (orto, meta, para	xylény	µg.l^{-1}	10	-

Indicator	Symbol	Unit	Value
WATER QUALITY INDICATORS - radioactivity indicators			
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}	µg.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

Indicator	Symbol	Unit	Value
WATER QUALITY INDICATORS - hydrobiological and microbiological indicators			
Saprobean biosestone index	SI_{bios}	-	2.4
SAS index (benthic invertebrates)	SAS	-	1.3
EPT index (binary invertebrates)	EPT	-	6
Phytoplankton biomass (chlorophyll-a)	CHL_a	µg.l^{-1}	50
Abundance of phytoplankton	ABU_{fy}	cells/ ml	10 000
Coliform bacteria	KB	CFU/ ml	100
Thermotolerant coliform bacteria	TKB	CFU/ ml	20
Enterococci intestinal	EK	CFU/ ml	10
Cultivable microorganisms at 22 °C	KM22	CFU/ ml	5 000

Decree of the Ministry of Agriculture and Rural Development of the Slovak Republic of 11 March 2013, amending Decree of the Ministry of Agriculture of the Slovak Republic no. 508/2004 Coll., Which implements Section 27 of Act no. 220/2004 Coll. on the protection and use of agricultural land and on the

amendment of Act no. 245/2003 Coll. on Integrated Prevention and Control of Environmental Pollution and on Amendments to Certain Acts

Limit values of risk elements in agricultural soil (in mg.kg^{-1} of dry mass, decomposition by aqua regia, for Hg – total content)										
Soil types	As	Cd	Co	Cr	Cu	Hg	Ni	Pb	Se	Zn	F
sand sand/silt	10	0.4	15	50	30	0.15	40	25	0.25	100	400
sitl/sand silt	25	0.7	15	70	60	0.5	50	70	0.4	150	550
Silt/clay clay	30	1.0	20	90	70	0.75	60	115	0.6	200	600

In relation – agriculture soil and plant

Analyte	**Symbol**	**Critical value** (in mg.kg^{-1} of dry mass in the 1 M NH_4NO_3 extract)
Arsenic	As	0.4
Copper	Cu	1.0
Nickel	Ni	1.5
Zinc	Zn	2.0
Cadmium	Cd	0.1
Lead	Pb	0.1
Analyte	**Symbol**	**Limit value**
Fluorine water-soluble	F	5.0 mg.kg^{-1}

Risk Substance	**Limit value** (mg.kg^{-1} dry mass)
Polycyclic aromatic hydrocarbon	1.00
Naftalen	0.05
Phenanthrene	0.05
Anthracene	0.05
fluoralithene	0.05
Pyrene	0.10
Benzo(a)anthracene	0.10
Chrysen	0.10
Benzo(b)fluoranthene	0.10
Benzo(k)fluoranthene	0.10
Indeno(1,2,3-cd)pyrene	0.10
Benzo(g,h,i)perylene	0.10
Chlorinated hydrocarbons	
Polychlorinated biphenyls	0.05
Chlorinated pesticides	
HCB	0.01
HCH	0.01
DDT	0.01
DDE, DDD	0.01
Other pesticides	
unchlorinated (individually)	1.00

Risk Substance	**Limit value** (mg.kg^{-1} dry mass)
Non-polar hydrocarbons	
non-polar substances (NEL)	100

I.3Quality objectives for hazardous substances (please complete the tables of HSs according to national documents)

I.4Listing of analytical standards (national analytics and international e.g. USEPA, ASTM, etc.) recommended in documents for chemical, physical, microbiological analyses of samples

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**.

Analytical standards (inorganic analysis, water)

RM		**Name**	**Concentration**	**Supplier**
Antimony	Sb	AN 9050 (1C)	1000 ±2 mg.l	ANALYTIKA, s.r.o., Prague
Arsenic	As	AN 9003 (1N)	1000 ±2 mg/l	ANALYTIKA, s.r.o., Prague
Beryllium	Be		1002 ± 5 µg/ml	ULTRA SCIENTIFIC
Cerium	Ce		1001 ± 5 µg/ml	ULTRA SCIENTIFIC
Tin	Sn		1001 ± 5 µg/ml	ULTRA SCIENTIFIC
Fluoride	F^-	CR-2159	1001 ± 5 µg/ml	ULTRA SCIENTIFIC
Phosphorus	P	HC85952747	3,99 ± 0,08 µg/l	Merck
Hafnium	Hf		1000 ± 5 µg/ml	ULTRA SCIENTIFIC

RM		Name	Concentration	Supplier
Magnesium	Mg	AN 9032 (1N)	1000 ±2 mg/l	ANALYTIKA, s.r.o., Prague
Chromium	Cr^{6+}		1001 ± 2 µg/ml	ULTRA SCIENTIFIC
	Cr^{6+}	AN 9079 (1H)	1000 ±2 mg/l	ANALYTIKA, s.r.o., Prague
Indium	In	NO81464	1000 ± 5 µg/ml	ULTRA SCIENTIFIC
Iridium	Ir	CM-6248	991,0 ± 8,6 µg/ml	ULTRA SCIENTIFIC
Iridium	Ir	NO81546	1001 ± 5 µg/ml	ULTRA SCIENTIFIC
Cobalt	Co	T00313	1001 ± 5 µg/ml	ULTRA SCIENTIFIC
Silicon	Si	AN 9053 (1H)	1000 ±2 mg/l	ANALYTIKA, s.r.o., Prague
Lanthanum	La	AN 9029 (1N)	1000 ±2 mg/l	ANALYTIKA, s.r.o., Prague
Manganese	Mn	CL-3978	1001 ± 5 µg/ml	ULTRA SCIENTIFIC
Copper	Cu	AN 9015 (1N)	1000 ±2 mg/l	ANALYTIKA, s.r.o., Prague
Molybdenum	Mo	CL-3557	1002 ± 5 µg/ml	ULTRA SCIENTIFIC
Nickel	Ni	CL-4110	1001 ± 5 µg/ml	ULTRA SCIENTIFIC
Lead	Pb	CL-3672	1002 ± 5 µg/ml	ULTRA SCIENTIFIC
Mercury	Mercury in Water	NCS ZC 76303	10 ± 0,4 ng/g	China
Mercury	Hg, Mercury ICP standard	CP5666	1002 ± 2 µg/ml	ULTRA SCIENTIFIC
Palladium	Pd	NO82088	1000 ± 5 µg/ml	ULTRA SCIENTIFIC
Rhenium	Re	NO81796	998,9 ± 3 µg/ml	ULTRA SCIENTIFIC
Rhodium	Rh	CM-5156	1001 ± 2 µg/ml	ULTRA SCIENTIFIC
Ruthenium	Ru	NO81490	1000 ± 5 µg/ml	ULTRA SCIENTIFIC
Sulfur	S	R00655	1000 ± 5 µg/ml	ULTRA SCIENTIFIC
Scandium	Sc ICP, ICP-MS standard	T00613	1001 ± 2 µg/ml	ULTRA SCIENTIFIC
Silver	Ag	AN 9001 (1N)	1000 ±2 mg/l	ANALYTIKA, s.r.o., Prague
Tantal	Ta	AN 9057 (1FN)	1000 ±2 mg/l	ANALYTIKA, s.r.o., Prague
Thorium	Th		1000 ± 5 µg/ml	ULTRA SCIENTIFIC
Titanium	Ti	AN 9061 (1FN)	1000 ±2 mg/l	ANALYTIKA, s.r.o., Prague
Carbon org.	TOC	CR 4416	1001 ± 5 µg/ml	ULTRA SCIENTIFIC
Uranium	U		1000 ± 5 µg/ml	ULTRA SCIENTIFIC
Vanadium	V		1001 ± 5 mg/l	ULTRA SCIENTIFIC
Tungsten	W	CM 2775	1000 ± 5 µg/ml	ULTRA SCIENTIFIC

RM		**Name**	**Concentration**	**Supplier**
Yttrium	Y	AN 9067 (1N)	1000 ±2 mg/l	
Zinc	Zn	T00108	1001 ± 5 µg/ml	ULTRA SCIENTIFIC
Zirconium	Zr	AN 9070 (1FN)	1000 ±2 mg/l	ANALYTIKA, s.r.o., Prague
Mixed standard (ICP Calibration Standard ICM-101)	Al,Ba,Be,Bi,B, Cd.Ca,Cr,Co, Cu,Ga,Fe,Pb,Li ,Mg,Mn,Ni,K,S e,Na,Sr,Te,Tl,Z n	CL-4996	cca 100 ± 0,5µg/ml	ULTRA SCIENTIFIC
Mixed standard TMDA-25.5	Al,Sb,As,Ba,Be ,Bi,B,Cd,Cr,Co ,Cu, Ga,Fe,Pb,Li,M n,Mo,Ni,Ru,Se, Ag,Sr,Tl,Sn,Ti, U,V,Zn	TMDA-25.5		Environment Canada
Mixed standard TMDA-25.5	Al,Sb,As,Ba,Be ,Bi,B,Cd,Cr,Co ,Cu, Ga,Fe,Pb,Li,M n,Mo,Ni,Ru,Se, Ag,Sr,Tl,Sn,Ti, U,V,Zn	TMDA-25.5		Environment Canada
Mixed standard TMDA-64.3	Al,Sb,As,Ba,Be ,Bi,B,Cd,Cr,Co ,Cu,Ga,Fe,Pb,Li ,Mn,Mo,Ni,Rb ,Se,Ag,Sr,Ta,S n,Ti,U,V,Zn	TMDA-64.3		Environment Canada
Thallium	Tl	NO81389	1001 ± 5 mg/l	ULTRA SCIENTIFIC

Analytical standards (inorganic analysis, XRF)

RM		**Supplier**
278	obsidian rock	NIST
694	phosphate rock	China
2704	bufallo river sediment	NIST
2709	San Joaguin soil	NIST
2710	Montana soil	NIST
2711	Montana soil	NIST
2CAS7	refractories (siliseous) firebrick	MBH, UK
2CAS8	refractories (siliseous) feldspar	MBH, UK
70a	potassium Feldspar	NIST
8-2-03	quartzite	Ostrava
8-3-01	magnesite	SMÚ Bratislava
8-3-02	magnesite	SMÚ Bratislava
8-4-02	Chromium magnesite	SMÚ Bratislava
92 RMs	magnesite	Ostrava
95 RMs	Chromium magnesite	Ostrava
97 RMs	Chromium magnesite	Ostrava
AGV- 1	andesite	USGS
AGV- 2	andesite	USGS
AN 11	chromium magnesite	MBH, UK
AN 27	alumina	MBH, UK
AN 38	magnesite	MBH, UK
AN-26	alumina	Intocast
BCR-2	Basalt	USGS
BCR-601	trace metals in lake sediment	N/A
BCS 319	magnesite	BAS
Bentonite 1	Bentonite natural	SMÚ Bratislava
BHVO-1	Basalt	USGS
BHVO-2	Basalt	USGS
BIR-1	Basalt	USGS
BPGM-1	heavy loamy sand	Poland
CCU-1b	Cu concentrate	Canada
1058	EDTA Calibration Material	LECO
CGL 021 MDL (DOLOMIT)	dolomite	Central Geological laboratory, Mongolia
COQ-1	Carbonatite	USGS
DGPM -1	Pinson Mine Disseminated Gold	USGS
DNC-1	diabase	USGS
EVO 1	Black coil ash	SMÚ Bratislava
DTS-2b	Dunite	USGS
FER-2	magnetite-silicate	Canada
G-2	granite	USGS
GBW 07406	NCS DC 73324	China
GBW 07407		China
G-88	basalt rock	NIST
GSP-1	granodiorite	USA
GSS - 5 (GBW 07405)	soil	UK
HS-1	marine sediment	Canada
IMEP-14		IRMM, Belgium
LKSD-1	lake sediment	Canmet, Canada

RM		**Supplier**
LKSD-3	lake sediment	Canmet, Canada
LOAM B	loam soil B	High-purity standards inc.
GSP-2	granodiorite	USGS
MAG-1	marine mud	Denver
MA-1b	gold ore	Canada
MGL-AND	andesite	Mongolia
MGL-ZEO-S	zeolite	Mongolia
MP – 1a	Zn–Sn–Cu–Pb ore	Canada
MW – 1	Iron ore	Canada
NCS DC 73310	stream sediment	China
NCS DC 62101a	portland cement	China
NCS DC 79002	phosphate rock (phosphorite)	China
NOD-P-1	Mn Nodule	USGS
PTC – 1a	Sudbury concentrate	Canada
PTM-1a	noble Metals-Bearing Ni-Cu Matte	Canada
QLO-1	quartz latite	USGS
RTS – 2	Sulphide ore mill tailings	Canada
RUS – 1	Cu-Zn ore	RVHP
Sandy B - SA - B		sandy soil B
BBOT LCRM	BBOT 502-897	LECO
CLB-1	Lower Bakerstown Coal	Denver
RUS – 2	Pyrite ore	RVHP
SARM 7	platinum ore	Africa
SARM 8	chromium ore	Africa
SARM 9	chromium ore	Africa
Sco-1	cody shale	USGS
SDC-1	MICA Schist	USGS
SDO-1	devonian Ohio Shale	USGS
S-SP	rendzina	N/A
SGR-1	green river shale	USGS
STSD-2	stream sediment	Canmet, Canada
STSD-3	stream sediment	Canmet, Canada
STSD-4	stream sediment	Canmet, Canada
STM-1	nepheline syenite	USGS
SY – 4	diorite Gneiss RM	Canada
Telgárt-EnviPT 2	stream sediment	SMÚ Bratislava
TB-2	tonschiefer	N/A
USZ 24-99 GAS	serpentinite	Mongolia
USZ 25-2006 TRM-2	rare earth ore	Mongolia
USZ 26-99 "Wmo"	tungsten-molybdenum ore	Mongolia
USZ 3-85,GSO 3319-85,	cupper-molybdenum ore CuMo	Mongolia
USZ 41-2006 OTX	gold-copper ore	Mongolia
USZ 42-2006 TRLK	rare earth ore	Mongolia
USZ 43-2006 Hg	mercury ore	Mongolia
Voznica	stream sediment	SMÚ Bratislava
W-2	diabase	USGS

I.5. List 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 (Ex: Microtox test - The potential ecological impacts of anaerobic degradation of vegetable oil on freshwater sediments; Hyalella Azteca etc).

Ecotoxicological tests

In Slovakia 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.6List of national and international guides of techniques on the design of sampling, transport, storage, samples preparation (sieving, fraction extraction, separation, etc.) recommended in documents

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.

I.7 Specify the recommended remedy measures associated with the contents of the hazardous substances (alert threshold, intervention threshold)

Directive of the Ministry of Environment of the Slovak Republic no. 1 / 2015-7 to develop a risk analysis of the contaminated area

he Directive regulates the procedure for:

- risk identification
- environmental risk assessment
- health risk assessment

- setting targets for remediation of the geological environment or remediation of environmental burdens,
- designing and evaluating options for remediation of the geological environment or remediation of the environmental burden, including an estimate of the necessary financial costs.

The target value of the contaminated site remediation is the concentration of pollutants for individual dominantly hazardous and harmful pollutants in the individual environmental components, which is recommended on the basis of a risk assessment with regard to existing and potential land use. This value must guarantee the protection of human health and the environment.
The remediation of contaminated areas includes remediation of environmental burdens and remediation of the geological environment aimed at eliminating pollution caused by human activity.
The subject of risk analysis is pollution in:
(a) the rock environment;
(b) soil and soil air;
(c) groundwater;
which can pose a serious threat to human health and the environment.

Risk analysis of contaminated sites is a crucial basis for decision-making of state administration bodies in the process of reducing the adverse effects of polluted territory on the environment and human health. It is a necessary and essential basis for:

a) setting targets for remediation of contaminated areas;
b) developing a remediation project;
c) an assessment of the effectiveness of remediation or their stages (an update of the contaminated area risk analysis is necessary);
d) a proposal for monitoring;
e) an assessment of the state of the territory examined on the basis of monitoring results.

If the pollution of the area presents a risk, it is necessary to remediate the contaminated area. The remedial measures are divided according to the way of intervention into the polluted area on:
a) active remediation,
b) passive remediation,
(c) monitored pollution.

Active remediation is an intervention in a polluted environment that removes pollution in a given area, up to the desired remediation targets, or to completely elimination of pollution.
Passive remediation is an intervention in a polluted environment that does not eliminate pollution, but technical barriers prevent the spread of pollution outside the area. The negative effect of harmful substances is limited only to contaminated space.
Monitored pollution is a situation where, for economic or technological reasons, it is not possible or expedient to carry out remediation and the entire contaminated area is only monitored. If pollution does not move, only emergency measures for emergency management and other organizational measures are prepared.

The selection of the appropriate remediation method is based on the assessment of the remediation scenarios (variants) expressing the different objectives of the contaminated site remediation and the technological procedures, including an estimate of the necessary financial costs.
For the purposes of further decision making, it is necessary to develop and compare 4 remediation scenarios (variants):

a) zero variant,
b) territory isolation
c) remediation for proposed remediation targets;
d) complete removal of pollution.

Act no. 409/2011 on certain measures in the field of environmental burdens

The law provides:

a) the rights and obligations of persons in identifying environmental burdens;
b) the method of determining the liable entity in the environmental burden area (hereinafter referred to as the “liable entity”),
c) the rights and obligations of the originator of the environmental burden (hereinafter referred to as the “originator”), the liable entity and the Ministry whose competence relates to the activity that led to the creation of the environmental burden (hereinafter referred to as “the relevant Ministry”).

II PRACTICES, EXPERIENCES

II.1.Significant national, European, finalized or ongoing projects related to geochemistry of waters, soils, sediments in the Danube basin

List of significant projects in Slovakia – focused on sediments

No.	Project title (national language, if available)	Project Title (EN)	Year	Country	Project coordinators, Partners
1	Monitorovanie riečnych sedimentov v rámci ČMS GF	Monitoring of river sediments within the Partial Monitoring System of geological factors	1996-ongoing	Slovakia	State geological institute of Dionyz Stur (SGIDS)
2	Zhodnotenie kvality sedimentov tokov a vodných nádrží	Evaluation of sediment quality in rivers and water reservoirs	2000-2004	Slovakia	Slovak hydrometeorological institute (SHMI)
3	Geochemický atlas riečnych sedimentov	Geochemical atlas of stream sediments	1991-1999	Slovakia	SGIDS
4	Zostavovanie geochemických máp riečnych sedimentov v rámci zostavovania súborov máp geologických faktorov životného prostredia	Construction of geochemical maps of river sediments as part of the compilation of maps of geological factors of the environment	1991-2010	Slovakia	SGIDS, private sector
5	Monitorovanie vplyvu VD Gabčíkovo na kvalitu povrchových vôd a sedimentov	Monitoring the impact of the Gabčíkovo water works on the quality of surface waters and sediments	1992 - ongoing	Slovakia	WaterWork Company, state enterprise, Bratislava
6	Vplyv antropogénnej činnosti v oblasti Zemplínskej Šíravy na kvalitu akumulovaných sedimentov	The impact of anthropogenic activity in Zemplínska Šírava on the quality of accumulated sediments	1997-2003	Slovakia	Water research institute (WRI)
7	Monitorovanie fyzikálno-chemických a biologických prvkov kvality vôd v roku 2008	Monitoring of physicochemical and biological elements of water quality in the year 2008	The project was completed in 2008	Slovakia	*SWME, s. e. - realized by its own capacities
8	Monitorovanie fyzikálno-chemických a biologických prvkov kvality vôd v rokoch 2009 - 2010	Monitoring of physicochemical and biological elements of water quality in the years 2009 - 2010	2009, 2010 and the project was completed in 2011	Slovakia	*SWME, s. e. - realized by its own capacities
9	Monitorovanie fyzikálno-chemických a biologických prvkov	Monitoring of physicochemical and biological elements of water quality in the	2012 – 2014. The project was completed in 2014	Slovakia	*SWME, s. e. - realized by its own capacities

	kvality vôd v rokoch 2012, 2013 a 2014	years 2012, 2013 and 2014			
10	Monitorovanie fyzikálno-chemických a biologických prvkov kvality vôd v roku 2015	Monitoring of physicochemical and biological elements of water quality in the year 2015	The project was completed in 2015	Slovakia	*****SWME, s. e. - realized by its own capacities
11	Monitorovanie fyzikálno-chemických a biologických prvkov kvality vôd v rokoch 2016 - 2020	Monitoring of physicochemical and biological elements of water quality in the years 2016 - 2020	2016 – 2020. The project is still being implemented	Slovakia	*****SWME, s. e. - realized by its own capacities
12		DanubeSediment „Danube Sediment Management - Restoration of the Sediment Balance in the Danube River“	1.1.2017 - 30.6.2019	Slovakia	***LP** – BME, HUNGARY, **PP** – BOKU, AUSTRIA; OVF, HUNGARY; NARW, ROMANIA; NIHWM, ROMANIA; LfU, GERMANY; NIMH-BAS, BULGARIA; EAEMDR, BULGARIA; HRVODE, CROATIA; IzVRS, SLOVENIA; VUVH, SLOVAKIA; TUM, GERMANY; JCI, SERBIA; Plovput, SERBIA; **ASP** – BAW, GERMANY; ICPDR, AUSTRIA; BMLFUW, AUSTRIA; Hidroelectrica, ROMANIA; ISRBC, CROATIA; DC, HUNGARY; WWF Hungary, HUNGARY; VVB, SLOVAKIA; MEWF, ROMANIA; VHP, AUSTRIA; MFAT, HUNGARY; GWP CEE, SLOVAKIA; DRSV, SLOVENIA; SWME, SLOVAKIA
13		FramWat „Framework for improving water balance and nutrient mitigation by applying small water retention measures“	1.7.2017 – 30.6.2020	Slovakia	***LP** - WULS-SGGW, POLAND; **PP** - GWP CEE, SLOVAKIA; SWME, SLOVAKIA; REC, HUNGARY; MTDWD, HUNGARY; Limnos, SLOVENIA; HRVODE, CROATIA; UL, SLOVENIA; WCL, AUSTRIA; **AP** – ICPDR, AUSTRIA; ISRBC, CROATIA; Ministry of Environment of the Slovak Republic, SLOVAKIA; Hungarian Chamber of Agriculture, HUNGARY; DRSV, SLOVENIA; Regional Water

					Board Warsaw, POLAND
14	Monitorovanie a hodnotenie stavu vôd III. etapa	Monitoring and assessment of water status – Phase III.	1.7.2015 – 31.12.2020	Slovakia	WRI

***Abbreviations:** LP – Lead partner, PP – Project partner, ASP – Associated strategic partner, AP – Associated partner; APBME, HUNGARY – Budapest University of Technology and Economics; BOKU, AUSTRIA – University of Natural Resources and Life Sciences, Vienna; OVF, HUNGARY - General Directorate of Water Management; NARW, ROMANIA - National Administration "Romanian Waters"; NIHWM, ROMANIA - National Institute of Hydrology and Water Management; LfU, GERMANY - Bavarian Environment Agency; NIMH-BAS, BULGARIA - National Institute of Meteorology and Hydrology – Bulgarian Academy of Sciences; EAEMDR, BULGARIA - Executive Agency "Exploration and Maintenance of the Danube River"; HRVODE, CROATIA - Croatian Waters - Legal entity for water management; IzVRS, SLOVENIA - Institute for Water of the Republic of Slovenia; VUVH, SLOVAKIA - Water Research Institute; TUM, GERMANY - Technical University of Munich, Chair of Hydraulic Research and Water Resources Management; JCI, SERBIA -Jaroslav Černi Institute for the Development of Water Resources ; Plovput, SERBIA - Republic of Serbia Ministry of Construction, Transport and Infrastructure Directorate for Inland Waterways; BAW - , GERMANY - Federal Waterways Engineering and Research Institute; ICPDR, AUSTRIA - International Commission for the Protection of the Danube River; BMLFUW, AUSTRIA - Federal Ministry of Agriculture, Forestry, Environment and Water Management; Hidroelectrica, ROMANIA -HIDROELECTRICA SA ; ISRBC, CROATIA - International Sava River Basin Commission; DC, HUNGARY - Danube Commission; WWF Hungary, HUNGARY - WWF World Wild Fund for Nature Hungary; VVB, SLOVAKIA - Water management construction, state enterprise; MEWF, ROMANIA - Ministry of Environment, Waters and Forests; VHP, AUSTRIA - VERBUND Hydro Power GmbH; MFAT, HUNGARY - Ministry of Foreign Affairs and Trade; GWP CEE, SLOVAKIA - Global Water Partnership Central and Eastern Europe; DRSV, SLOVENIA - SLOVENIAN WATER AGENCY; SWME, SLOVAKIA - Slovak Water Management Enterprise, state enterprise; WULS-SGGW, POLAND - Warsaw University of Life Sciences; REC, HUNGARY - The Regional Environmental Center for Central and Eastern Europe; MTDWD, HUNGARY - Middle Tisza District Water Directorate; Limnos, SLOVENIA - LIMNOS Ltd, Company for applied ecology; UL, SLOVENIA - University of Ljubljana; WCL, AUSTRIA - WasserCluster Lunz – biologische Station GmbH

II.2. Significant scientific papers, books, related to geochemistry of waters, soils, sediments in the Danube basin

No.	Paper title (national language,if available)	Title (EN)	Year	Country	Authors
1	Geochemický atlas Slovenskej republiky, časť VI. Riečne sedimenty.	Geochemical atlas of the Slovak republic, part VI. Stream sediments.	1999	Slovakia	Bodiš, D., Rapant, S., Khun, M., Klukanová, A., Lexa, J., Mackových, D., Marsina, K., Pramuka, J., Vozár. J.
2	Hodnotenie zanášania vodohospodárskych nádrží SR vo vzťahu k zmenám retenčného objemu a možnostiam zlepšenia ich ekologického stavu I, časť Hodnotenie environmentálnych vlastností sedimentov	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).	2018	Slovakia	Čuban

No.	Paper title (national language,if available)	Title (EN)	Year	Country	Authors
	(VS Palcmanská Maša). VÚVH Bratislava.	VÚVH Bratislava.			
3	Hodnotenie zanášania vodohospodárskych nádrží SR vo vzťahu k zmenám retenčného objemu a možnostiam zlepšenia ich ekologického stavu I. časť Hodnotenie environmentálnych vlastností sedimentov (VS Hričov). VÚVH Bratislava.	Evaluation of the Waste Water Management of the Slovak Republic in relation to the changes in the retention volume and the possibilities for improvement of their ecological state I, part Evaluation of Environmental Properties of Sediments (VS Hričov). VÚVH Bratislava.	2017	Slovakia	Čuban
4	Rámcový program monitorovania vôd Slovenska na obdobie rokov 2016 – 2021. Ministerstvo životného prostredia Slovenskej republiky. Bratislava, december 2015.	Framework Program for the monitoring of Slovak waters for the period 2016 - 2021. Ministry of the Environment of the Slovak Republic. Bratislava, December 2015.	2015	Slovakia	
5	N Á R O D N Á R O Č N Á S P R Á V A z monitorovania prírodného prostredia na slovenskom území za rok 2012 podľa "Dohody medzi vládou Slovenskej republiky a vládou Maďarskej republiky o niektorých dočasných technických opatreniach a o prietokoch do Dunaja a Mošonského ramena Dunaja" podpísanej dňa 19. apríla 1995.	NATIONAL ADMINISTRATION from the monitoring of the natural environment to Slovak territory for 2012 according to the "Agreement between the Government of the Slovak Republic and the Government of the Republic of Hungary on Certain Temporary Technical Measures and Tributaries to the Danube and the Moesian Arm of the Danube", signed on 19 April 1995.	1995		
6	Hodnotenie environmentálnych vplyvov sedimentov malých vodných nádrží a možnosti ich riešenia. VÚVH Bratislava.	Evaluation of environmental impacts of sedimentation of small water reservoirs and possibilities of their solution. VÚVH Bratislava.	2011	Slovakia	Hucko, P.
7	Hodnotenie kvality sedimentov vodnej stavby Sigord. Záverečná správa. VÚVH Bratislava.	Evaluation of sediment quality of the Sigord water structure. Final report. VÚVH Bratislava.	2011	Slovakia	Hucko, P.
8	Vplyv eróznych procesov v povodí na	Influence of erosion processes in river basins on	2009	Slovakia	Hucko, P.

No.	Paper title (national language,if available)	Title (EN)	Year	Country	Authors
	kvalitu vody v tokoch. Záverečná správa. VÚVH Bratislava	water quality in streams. Final report. VÚVH Bratislava			
9	Hodnotenie environmentálnych vplyvov sedimentov vodných nádrží a možnosti ich riešenia. VÚVH Bratislava.	Assessment of environmental impacts of sedimentation of water reservoirs and possibilities of their solution. VÚVH Bratislava.	2007	Slovakia	Hucko, P.
10	Analýzy dnových sedimentov podľa požiadavky MP MŽP SR č. 549/98-2. VÚVH Bratislava.	Analyzes of bottom sediments as required by the Ministry of Environment of the Slovak Republic no. 549 / 98-2. VÚVH Bratislava.	2007	Slovakia	Hucko, P.
11	Vplyv eróznych procesov v povodí na kvalitu vody v tokoch. VÚVH Bratislava.	Effect of erosion processes in the catchment on water quality in streams. VÚVH Bratislava.	2007	Slovakia	Hucko, P.
12	Riešenie problematiky sedimentov vodných nádrží a možností ich využitia. VÚVH Bratislava.	Solving the problems of sedimentation of water reservoirs and possibilities of their utilization. VÚVH Bratislava.	2007	Slovakia	Hucko, P., Kovalčík, B.
13	Posúdenie vplyvu ťažby sedimentov na VD Hričov. VÚVH Bratislava.	Assessment of the impact of sediment extraction on VD Hričov. VÚVH Bratislava	2007	Slovakia	Hucko, P.
14	Vplyv eróznych procesov v povodí na kvalitu vody v tokoch. VÚVH Bratislava.	Influence of erosion processes in river basins on water quality in streams. VÚVH Bratislava.	2006	Slovakia	Hucko, P., Kušnír, P.
15	Vplyv mikrobiálnych procesov v sedimentoch vodných tokov a nádrží na transformáciu látok pochádzajúcich z bodových zdrojov znečistenia. VÚVH Bratislava.	Influence of microbial processes in sediments of water streams and reservoirs for the transformation of substances originating from point sources of pollution. VÚVH Bratislava.	2005	Slovakia	Hucko, P., Kušnír, P.,
16	Ovplyvnenie kvality povrchových vôd a riečnych sedimentov organickými látkami z bodových zdrojov znečistenia vo	Influence of the quality of surface waters and river sediments with organic substances from point sources of pollution in selected areas. VÚVH Bratislava.	2004	Slovakia	Hucko, P., Weigeltová, S., Kušnír, P

No.	Paper title (national language,if available)	Title (EN)	Year	Country	Authors
	vybraných oblastiach. VÚVH Bratislava.				
17	Verifikácia systému nakladania so sedimentami z vodohospodárskych nádrží. VÚVH Bratislava.	Verification of the sediment management system from water reservoirs. VÚVH Bratislava.	2003	Slovakia	Hucko, P., Šumná, J.
18	Úloha RVT č. 27-34 Výskum vplyvu antropogénnych faktorov na vodné systémy. Čú06 bodové zdroje znečistenia a manažment kvality v povodí riek váh a hron. Etapa 06.1 Transport a transformácia látok vo vodnom prostredí povrchových tokov. Záverečná správa VÚVH Bratislava.	Project RVT no. 27-34 Research on the Impact of Anthropogenic Factors on Water Systems. Čú06 point pollution sources and quality management in river basin and hron river basins. Stage 06.1 Transport and transformation of substances in the aqueous media of surface streams. Final report of the WRC Bratislava	2002	Slovakia	Hucko, P. et al.
19	VTP č. 514-78 Výskum upraviteľnosti pitnej vody a environmentálne aspekty vodných tokov. Záverečná správa etapy 03.05 Vplyv režimu splavenín a plavenín v oblastiach ovplyvnených vodnými dielami na kvalitu vôd. VÚVH Bratislava.	VTP č. 514-78 Research on Potable Water Treatment and Environmental Aspects of Watercourses. Final Report of Stage 03.05 The impact of floodplain and floating regime in areas affected by water works on water quality. VÚVH Bratislava	1999	Slovakia	Hucko, P., Holubová, K., Szolgay, J.
20	Čiastkový monitorovací systém – geologické faktory, správa za obdobie 2002 – 2009, záverečná správa.	Partial monitoring system - geological factors, report 2002 - 2009, final report.	2011	Slovakia	Iglárová, Ľ., Wagner, P., Hrašna, M., Cipciar, A., Frankovská, J., Bajtoš, P., Smolárová, H., Gluch, A., Vlčko, J., Bodiš, D., Klukanová, A., Ondrášik, M., Ondrejka, P., Liščák, P., Pauditš, P., Petro, Ľ., Dananaj, I., Hagara, R., Moczo, P., Labák, P., Kristeková, M., Ferianc, D., Vanko, J., Kováčiková, M., Záhorová, Ľ., Mikita, S., Matys, M., Gajdoš, V., Masarovičová, M., Slávik, I., Vybíral, V., Rapant, S., Greif, V., Brček, M., Kordík, J. a

No.	Paper title (national language,if available)	Title (EN)	Year	Country	Authors
					Slaninka, I.,
21		Arsenic mobility from anthropogenic impoundment sediments, consequences of contamination to biota, water and sediments, Poša, Eastern Slovakia. Applied Geochemistry.	2009	Slovakia	Hiller E., Jurkovič, Ľ., Kordík J., Slaninka I., Jankulár, M., Majzlan J., Göttlicher, J., Steininger, R.
22	Monitoring kvality povrchových vôd a sedimentov tokov, kanálov a zdrže ovplyvnených vodným dielom Gabčíkovo. Záverečná správa za obdobie do 31. 12. 2004.	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.	2005	Slovakia	Valúchová, M., Kobelová, M., Hucková, A., Tarabová, M., Nagy, Š.
23	Geochemická mapa riečnych sedimentov regiónu Myjavská pahorkatina a Biele Karpaty.	Geochemical map of river sediments of the Myjavská pahorkatina region and the White Carpathians.	2005	Slovakia	Slaninka, I., Kordík, J.
24	Mobilizácia vybraných potenciálne toxických stopových prvkov z riečnych a dnových sedimentov a hodnotenie rizík ich vstupu do prostredia pri rôznom spôsobe nakladania so sedimentmi. Dizertačná práca.	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.	2018	Slovakia	Pažická, A.
25	Monitorovanie riečnych sedimentov na Slovensku. Mineralia Slovaca, 44.	Monitoring of river sediments in Slovakia. Mineralia Slovaca, 44.	2012	Slovakia	Kordík, J., Slaninka, I., Bodiš, D.
26	Hodnotenie vplyvu environmentálnych záťaží na podzemné vody a sedimenty v oblasti Serede. Podzemná voda. Roč. 22, č. 2.	Assessing the impact of environmental loads on groundwater and sediments in the Sereď area. Podzemná voda. Vol. 22, no. 2.	2016	Slovakia	Kordík, J., Šuranová, A., Jankulár, M., Klárisová, K., Ženišová, Z., Jurkovič, Ľ.
27	Kvalitatívne hodnotenie riečnych sedimentov vybraných tokov Slovenska – toxické prvky. Záverečná správa geologickej úlohy.	Qualitative assessment of river sediments of selected Slovakia streams and rivers – toxic elements. Final report.	2013	Slovakia	Bodiš, D., Kordík, J., Slaninka, I.

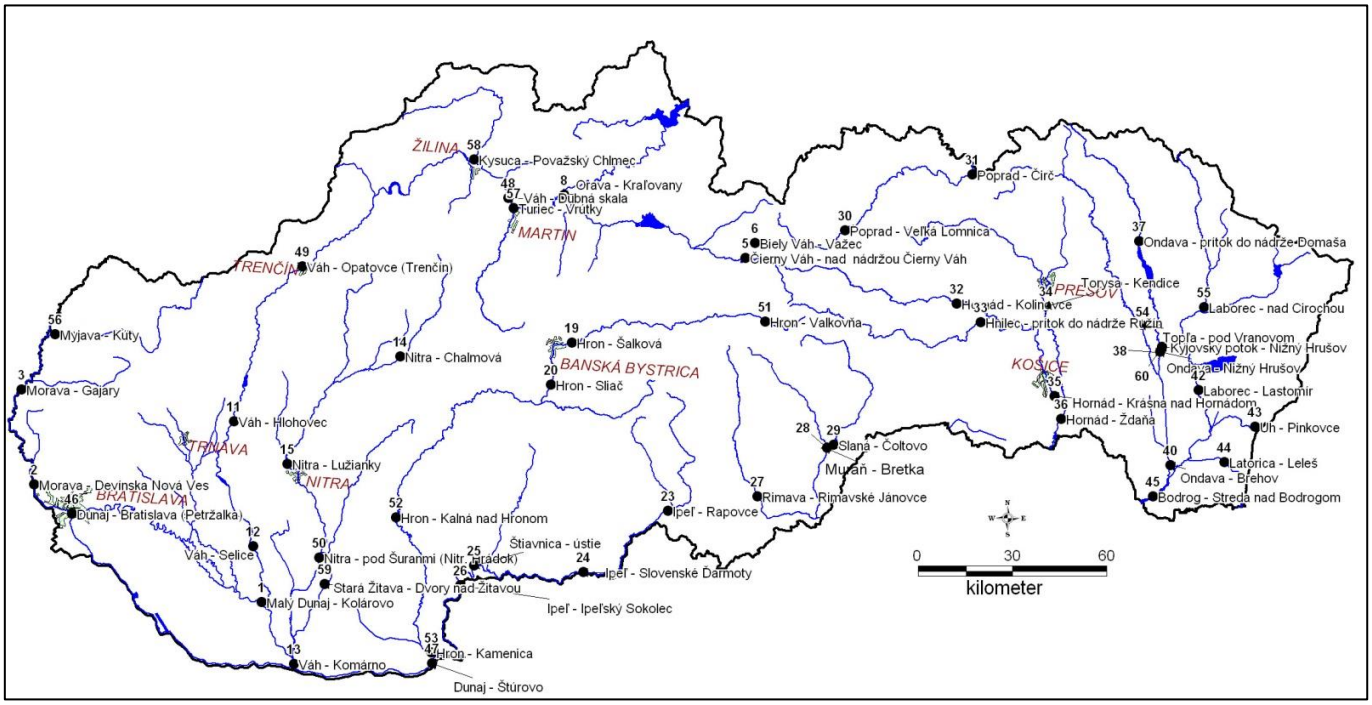
II.3 Existent waterbodies and sampling sites (Ramsar, Natura2000 etc.) and current quality monitoring stations of the Danube River

Monitoring of stream sediments carried out by SGIDS

Danube River Quality Monitoring Stations

No.	Site	Country	Note
1	Dunaj – Bratislava	SK	SGIDS monitoring
2	Dunaj – Štúrovo	SK	SGIDS monitoring

Other Stations



ID	Locality	X_JTSK	Y_JTSK
1	Malý Dunaj - Kolárovo	-510999	-1310727
2	Morava - Devínska Nová Ves	-583254	-1273445
3	Morava - Gajary	-587260	-1243252
4	Morava - Brodské	-576279	-1219880
5	Čierny Váh - nad nádržou Čierny Váh	-357418	-1201643
6	Biely Váh - Važec	-354354	-1196797
7	Váh - Lisková	-399552	-1190915
8	Orava - Kraľovany	-414862	-1181627
9	Váh - nad Žilinou	-432304	-1178534
10	Váh - pod Dubnicou	-490387	-1197635
11	Váh - Hlohovec	-519700	-1253494
12	Váh - Selice	-513761	-1293088
13	Váh - Komárno	-500693	-1330426
14	Nitra - Chalmová	-467018	-1232789
15	Nitra - Lužianky	-502842	-1267013
16	Nitra - Nové Zámky	-495309	-1304745

ID	Locality	X_JTSK	Y_JTSK
17	Žitava - Lúčnica	-485234	-1281309
18	Hron - Polomka	-364885	-1219940
19	Hron - Šálková	-412517	-1228416
20	Hron - Sliač	-419194	-1241705
21	Hron - Tekovská Breznica	-460401	-1264677
22	Hron - Kamenín	-461003	-1320520
23	Ipeľ - Rapovce	-381977	-1281745
24	Ipeľ - Slovenské Ďarmoty	-408752	-1301277
25	Štiavnica - ústie	-443501	-1299105
26	Ipeľ - Ipeľský Sokolec	-447937	-1305500
27	Rimava - Rimavské Jánovce	-353536	-1277192
28	Muráň - Bretka	-331531	-1261792
29	Slaná - Čoltovo	-329264	-1260946
30	Poprad - Veľká Lomnica	-325764	-1192721
31	Poprad - Čirč	-285233	-1175060
32	Hornád - Kolinovce	-290298	-1216143
33	Hnilec - prítok do nádrže Ružín	-282625	-1221965
34	Torysa - Kendice	-261866	-1216823
35	Hornád - Krásna nad Hornádom	-259114	-1245377
36	Hornád - Ždaňa	-257022	-1252744
37	Ondava - prítok do nádrže Domaša	-232310	-1196188
38	Ondava - Nižný Hrušov	-225679	-1231325
39	Topľa - Božčice	-227592	-1236233
40	Ondava - Brehov	-222449	-1267386
41	Laborec - Brekov	-218795	-1221376
42	Laborec - Lastomír	-213522	-1243444
43	Uh - Pinkovce	-195441	-1255121
44	Latorica - Leleš	-205316	-1266468
45	Bodrog - Streda nad Bodrogom	-228023	-1277277
46	Dunaj - Bratislava (Petržalka)	-571322	-1282763
47	Dunaj - Štúrovo	-456813	-1330289
48	Váh - Dubná skala (Nezbudská Lúčka)	-432725	-1182464
49	Váh - Opatovce (Trenčín)	-498052	-1204320
50	Nitra - pod Šuranmi (Nitriansky Hrádok)	-492695	-1296708
51	Hron - Valkovňa	-351001	-1221758
52	Hron - Kalná nad Hronom	-468299	-1284010
53	Hron - Kamenica	-457024	-1326717
54	Topľa - Vranov nad Topľou	-231481	-1222756
55	Laborec - nad sútokom s Cirochou (Lackovce)	-211791	-1217176
56	Myjava - Kúty	-576515	-1225697
57	Turiec - Vrútky	-430956	-1185752
58	Kysuca - Považský Chlmec	-443448	-1170237
59	Stará Žitava - Dvory nad Žitavou	-490900	-1305011
60	Kyjovský potok - Nižný Hrušov	-225131	-1229823

Surface water quality monitoring (SHMI)

The qualitative indicators monitored at all monitored sites (basic and operational) are evaluated pursuant to Section 3, paragraph 3 of the Governmental Regulation No. 269/2010 Coll. as amended by Governmental Regulation No. 398/2012 Coll.

Measured data of individual indicators were statistically processed and the compliance with the requirements given in Annex No. 1 of Government Regulation No. 269/2010 Coll. as amended by Government Regulation No. 398/2012 Coll. was evaluated. For the evaluation of qualitative indicators of surface water according to Annex No. 1, the 90^{th} percentile or the 10^{th} percentile (for the O_2 indicator), calculated from the measured values for given year, is used.

In total, 385 sites in basic and operational monitoring is monitored recently.

Table 1: Number of monitored surface water sites by sub-basin in 2015

Sub-basin	Number of scored places by type of monitoring			
	Basic	Operational	Basic and operational	Total
Morava		4	25	29
Dunaj		3	14	17
Váh	12	66	72	150
Hron		17	28	45
Ipeľ		8	15	23
Slaná		10	10	20
Bodrog		10	47	58
Hornád	1	5	15	20
Bodva		1	8	9
Dunajec and Poprad		5	9	14
Total	13	129	243	385

As a rule, the frequency of monitoring is evenly distributed over a calendar year, ie. 12 times per year in accordance with the monitoring program. Lower frequency of monitoring have some biological indicators monitored by the season (2 – 7 x per year), radioactivity indicators (with frequency 4 times a year) and relevant substances with a frequency of 4 times a year.

Water management balance of surface water quality (SHMI)

Processing of water management quality balance of surface water come out from:

- monitoring and evaluation of surface water quality of Slovakia,
- the annual balance of discharges and wastewater pollution,
- the results of the assessment of the quantity and regime of surface waters,
- from the informative report of the Slovak Environmental Inspectorate on extraordinary deterioration of water,
- legislation defining requirements for surface water quality and Environmental Quality Standards (EQS) for relevant substances, priority substances and some other pollutants:
    - Government Regulation No. 269/2010 Coll. as amended by Act No. 398/2012 Coll. laying down and supplementing the requirements for achieving good status waters
    - Government Regulation No. 167/2015 Coll. on environmental quality standards in water policy

- from the EC reporting requirements for the implementation of individual EU directives:
    - Council Directive 91/271 / EEC of 21 May 1991 concerning urban cleaning sewage treatment
    - Council Directive 91/676 / EEC of 12 December 1991 concerning the protection of waters by nitrate pollution from agricultural sources
    - Regulation (EC) No 1782/2003 of the European Parliament and of the Council Of 18 January 2006 establishing a European Pollutant Release and Transfer Register (E-PRTR) amending Council Directives
- from assessing the ecological status / ecological potential and the chemical status for the reference years 2009-2012, which was part of the Slovak Water Plan (second planning cycle).

Balanced indicators are as follows:

- General physico-chemical and hydrobiological indicators
- Relevant synthetic and non-synthetic specific substances for SR
- Priority and some other pollutants.

The balance (BS) is expressed as the ratio of allowable pollution ($C_{prip.}$) to the value of actual pollution ($C_{skut.}$). The resulting balance in the monitored location is determined by an indicator with the least favorable (lowest) calculated ratio.

BS = Cpríp. / Cskut.

Balance (BS) is evaluated by 3 levels:

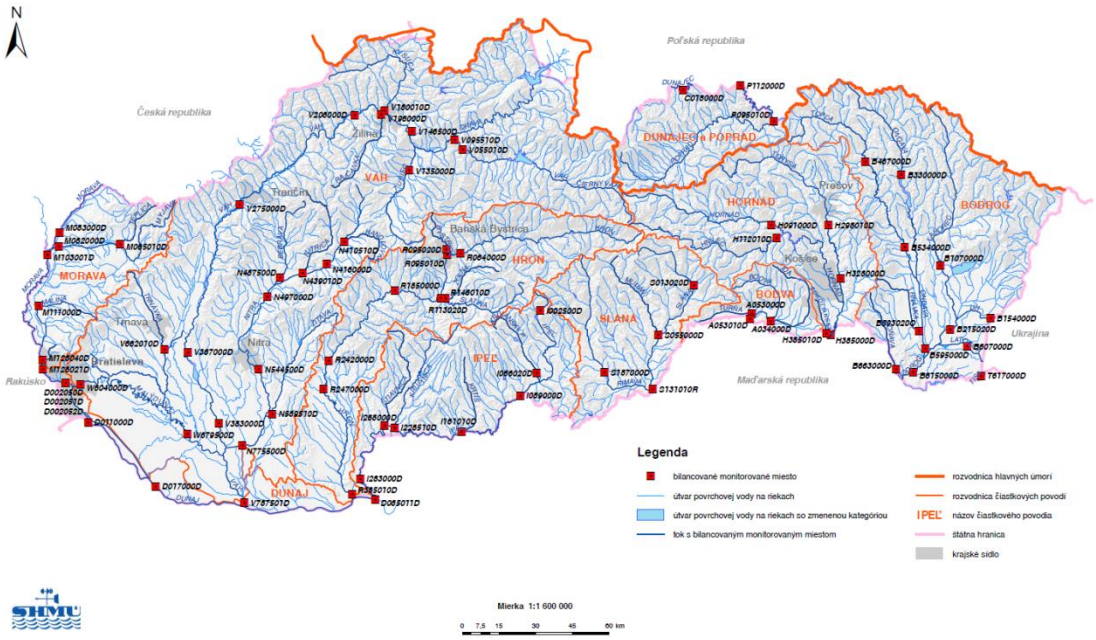
A - favorable BS ≥ 1.1
B - tense 0.9 < BS < 1.1
C - passive 0.9 ≥ BS.

$C_{príp.}$ - permissible pollution is expressed by the requirements according to Annex no. 1 and 12 of the Government Regulation of the SR no. 269/2010 Coll. [3] and Annex no. 1 of the Government Regulation of the SR no. 167/2015 Coll.

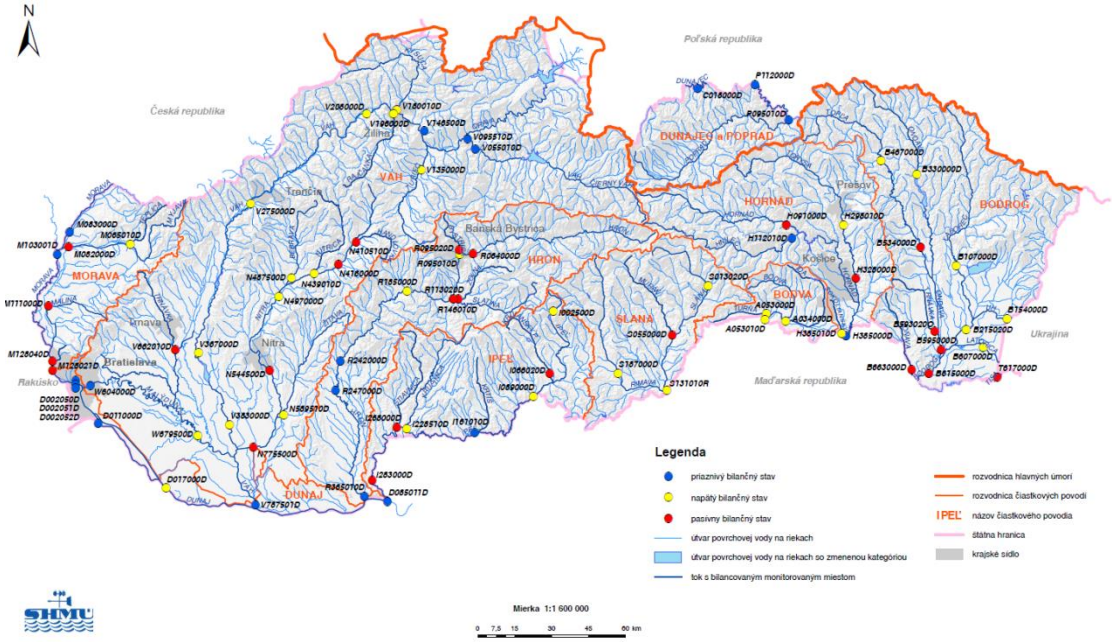
$C_{skut.}$ - actual pollution is expressed as a 90-percentile percentile calculated from the measured values of the indicator per calendar year.

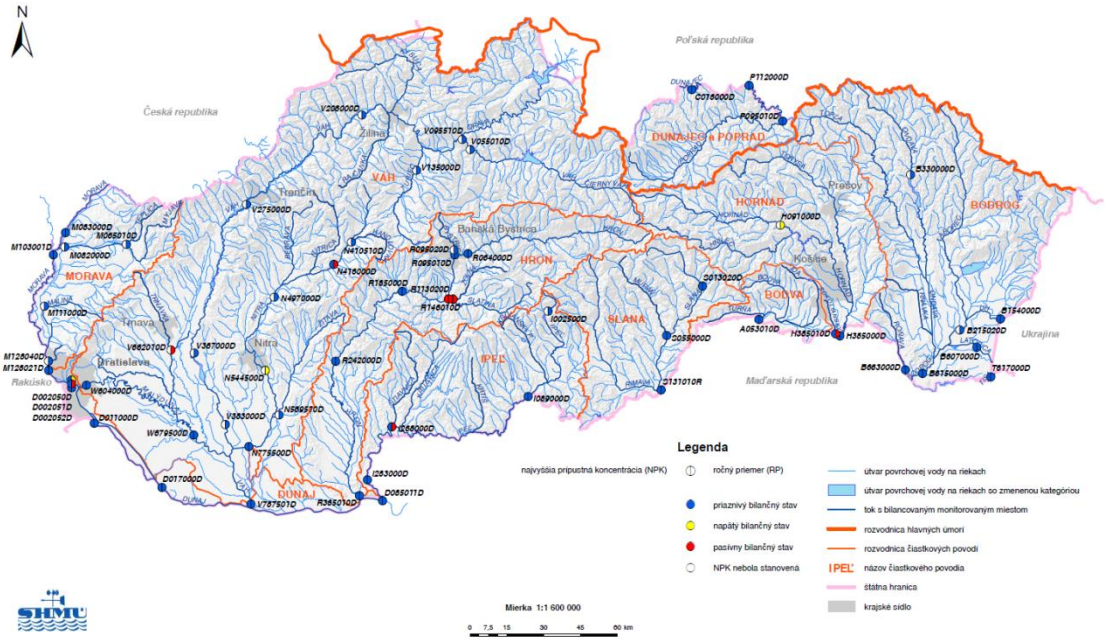
The calculation is subject to a minimum of 4 measurements per year.

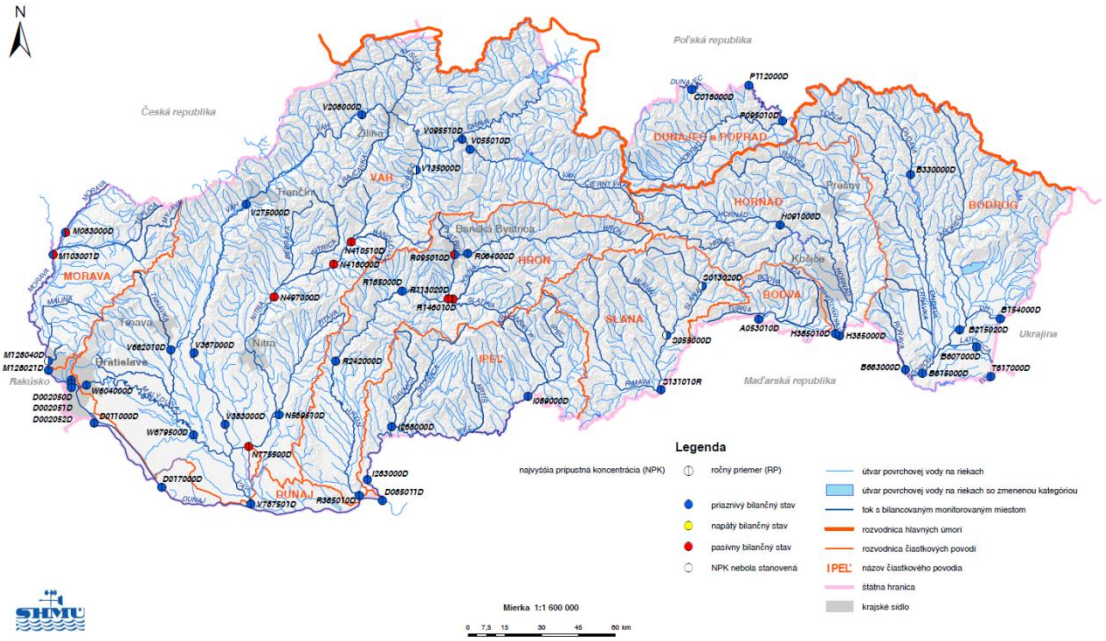
Balanced monitoring sites of surface water quality in Slovakia in 2014



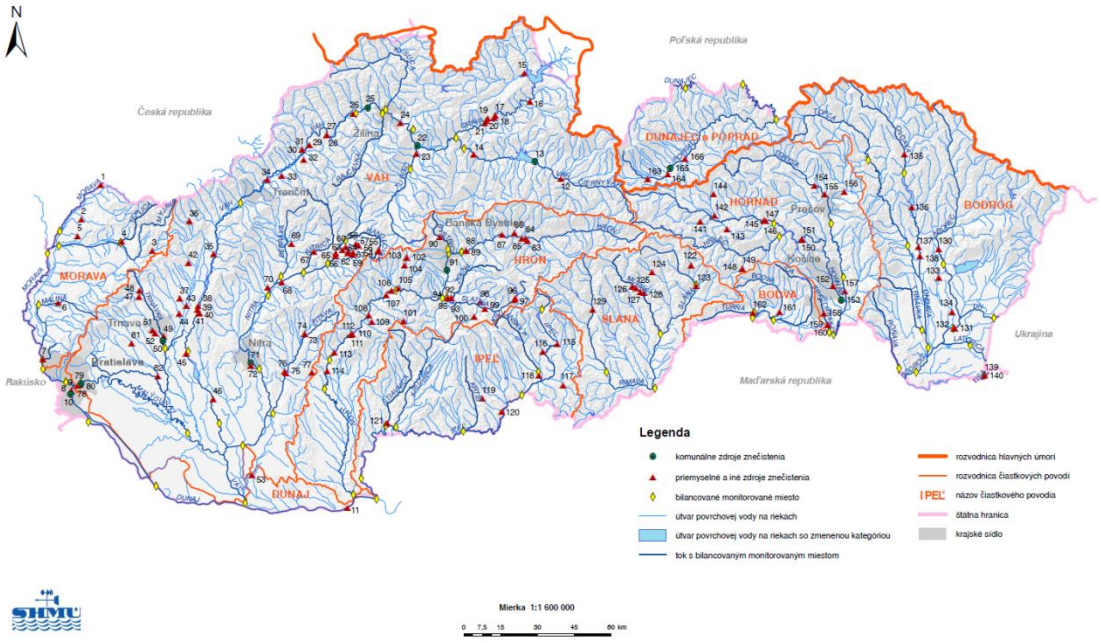
Water management balance of surface water quality in 2014 – General physico-chemical and hydrobiological indicators







Significant sources of pollution (municipal, industrial and other sources of pollution) for 2014



II.4.Data and metadata availability (including information on ambient or natural concentrations of HSs for establishing intervention measures)

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.

Monitoring of stream sediments carried out by SGIDS – Data and metadata availability

Table: CMS_RS_databaza (basic database of chemical composition of river sediments)		
field mark	field type	field description
ID_lokalit	text (4)	site identificator
ID_analyza	number (integer)	serial number of analysis (identifier)
Zn_mb	text (10)	serial number of the monitored site (identifier)
ID_laboratorium	number (integer)	laboratory number
X_map	number (double)	x-coordinate in JTSK (m)
Y_map	number (double)	y-coordinate in JTSK (m)
Lokalita	text (100)	the name of the monitoring station
datum	date/time	date of sampling of the river sediment
odobral	text (50)	the name of the person (s) sampling the river sediment
Analysis: Na, K, Ca, Mg, Fe, Mn, Al, As, Cd, Co, Cr, Cu, Hg, Ni, Pb, Sb, Se, Zn, TOC, SiO2, Ba, Mo, Sn, Sr, V, Zr, PAH, PCB, pesticides	number (double)	Sodium concentration (%)

Table: CMS_RS_popis_lokalit (description: basic localization data of monitoring points)		
field mark	field type	field description
ID_lokalit	text (4)	site identificator
Lokalita	text (100)	the name of the monitoring station
ZUJ	text (6)	basic territorial unit
Zm_50	text (5)	map at a scale 1:50 000
Geologia	text (250)	geological settings
Zac_mer	text (4)	start of measuring
Kon_mer	text (4)	end of measuring
Opis_lokal	text (250)	more detailed description of the monitoring station
Zn_mb	text (10)	serial number of the monitored site (identifier)
X_JTSK	number (double)	x-coordinate in JTSK (m)
Y_JTSK	number (double)	y-coordinate in JTSK (m)
Z	number (double)	z-coordinate (m a.s.l.)
lokalizacia_mapa	hyperlink	Locating of the monitoring object on the map
blizsi_popis_SHMU	text (250)	description of SHMI surface water monitoring site
riecny_kilometer	number (double)	river flow rate kilometer monitored by the SHMI
poznamka_sediment	text (150)	remark
fotodokumentacia	hyperlink	Site photo

Table: CMS_RS_mineralogical analysis (results of mineralogical analysis)		
field mark	field type	field description
Zn_mb	text (10)	serial number of the monitored site (identifier)
ID_miner_analyza	number (integer)	mineralogical analysis identifier
X_map	number (double)	x-coordinate in JTSK (m)
Y_map	number (double)	y-coordinate in JTSK (m)
laboratorium_miner	text (150)	laboratory that performed a mineralogical analysis
analyzoval	text (50)	the person responsible for the mineralogical analysis
Lokalita	text (100)	the name of the monitoring station
hlavne_mineraly	text (100)	major minerals > 15%
vedlajsie_mineraly	text (150)	accessory minerals ~ 3 - 15%

Table: CMS_RS_zrnitostna_analyza (granulometric analysis results)		
field mark	field type	field description
Zn_mb	text (10)	serial number of the monitored site (identifier)
ID_zrn_analyza	number (integer)	granulometric analysis identifier
X_map	number (double)	x-coordinate in JTSK (m)
Y_map	number (double)	y-coordinate in JTSK (m)
laboratorium_zrnit	text (150)	laboratory where granulometric analysis was performed

laborant	text (50)	the person responsible for the granulometric analysis
strk	number (double)	gravel fraction above 2 mm (%)
piesok	number (double)	sandy fraction – 0,063-2 mm (%)
prach	number (double)	silty fraction – 0,002-0,063 mm (%)
il	number (double)	clayey fraction less than 0,002 mm (%)
hlina_il	number (double)	loamy and clayey fraction less than 0,063 mm (%)

The list of past or current economic polluters referring to the direct effect on the quality of sediment in the Danube:

Bekaert, a.s. Hlohovec *
Bloomsburry (Novoker) Lučenec
Bloomsburry (Novoker) Lučenec
Bučina a.s. Zvolen
Bukocel, a.s. Hencovce
Comax - TT, a.s. Trnava
ČOV : Senica, Skalica, Petržalka, Vrakuňa, Modra, Trenčín - pravá strana, Šaľa, Komárno, Šahy
Duslo, a. s. Šaľa
EBO elektrárne
Elektrokarbon, a.s. Topoľčany *
EMO Elektrárne
Energoblok ,a.s. Brezová pod Bradlom *
ETI ELB, s.r.o. Báhoň *
Harmanecké papierne Harmanec
Chemko, a. s. Strážske
Chemolak, a.s. Smolenice
Chemosvit, a.s. Svit
Chirana Prema Energetika a.s. Stará Turá *
Ipodex Onyx Kroch s.r.o Banská Bystrica *
Istrochem, a.s. Bratislava
Izomat, a. s. Nová Baňa
Kappa, a. s. Štúrovo
Kinex a.s. Skalica *
Kinex a.s., Bytča *
Kovohuty Krompachy
Koželužne Bošany
Matador, a.s. Púchov
NCHZ, a. s. Nováky
OFZ, a.s. Istebné Široká*
OND a BECK, s.r.o. Kolárovo
Petrochema, a.s. Dubová
SCP, a. s. Ružomberok
SE a.s. at. el. Jaslovské Bohunice
SE, a.s. OZ Vojany
Slovenské Elektrárne Mochovce
Slovenské elektrárne, a.s. Zemianske Kostoľany *
Slovenský hodváb, a.s. Senica

Slovglass, a.s. Poltár
Slovnaft, a. s. Bratislava
SLZ Hnúšťa
SMZ Jelšava
Tesgal s.r.o. Vráble *
Tesla Stropkov a.s. *
Tesla, a.s. Liptovský Hrádok *
Transpetrol , a.s. Bučany *
Transpetrol, a.s., Hrkovce *
U. S. Steel Košice, s.r.o. Košice
Vegum, a.s. Dolné Vestenice
Vihorlat s.r.o. Snina *
Volkswagen Slovakia, a.s. Bratislava
Vulkán , a.s. Bošany
ZSNP, a.s. Žiar nad Hronom *

II.5.Problems of current monitoring procedures in DRB

III.INVENTORY OF SAMPLING METHODOLOGIES

III.1. Water

III.1.1. Sampling design strategy. How do you choose sampling locations,number of sites, sampling position within the national Danube sector, distance from confluence points, distance from point industry/agriculture polluters, distance from big cities, sampling depth, distance from the water course/bodies banks? How do you decide about temporal frequency of collecting samples?

III.1.2. Which parameters of water **quality/quantity** are measured ***in situ***?

- Temperature (water, air), pH, Eh, Ec, O_2

III.1.3. Which **instruments** are used for ***in situ*** measurements (include manufacturer and type)?

- Multimeter WTW

III.1.4. Please, describe **methodology** for ***in situ*** measurements.

- flow cell

III.1.5. Which **tools** are used for collecting samples for **laboratory** measurements (include manufacturer and type)?

- Simple equipment

III.1.6 Sample preservation (samples chemical preservation according to their type and used analysis method).

- See below (example Geochemical Atlas of Europe)

III.1.7 Please, describe a **methodology** for collecting samples.

- See below (example Geochemical Atlas of Europe)

Slovakia (SGIDS) participated on the project „**Geochemical Atlas of Europe**. Part 1 - Background Information, Methodology and Maps". A precised and detailed sampling strategy was established and FOREGS GEOCHEMICAL MAPPING FIELD MANUAL was created. Details see:
http://weppi.gtk.fi/publ/foregsatlas/index.php
Running stream water was collected from the small, second order, drainage basin (< 100 km2) at the same site as the active stream sediment.
All hand jewellery must be removed. All tools and containers must be free of contaminants.

Water samples to be collected:

1 x 500 ml bottle unfiltered water for major IC ion analysis
1 x 100 ml bottle filtered water for ICP-MS and ICPAES analysis
1 x 60 ml bottle for DOC analysis
1 x 100 ml bottle for mercury analysis
Duplicate water sample: From one sampling site of a duplicate cell (one in each country) 2 bottles of each type will be required.

Equipment to be provided by regional laboratories:

-500 ml new polyethylene bottles (for non-filtered water samples for major IC ion analysis)
-60 ml new polyethylene bottles (for filtered, unacidified samples for DOC analysis, DOC= Dissolved Organic Carbon)
-Disposable gloves (Medi-Point vinyl gloves, powder free or comparable)
-Disposable syringes (e.g. Becton & Dickinson

-Disposable filters 0.45 µm (e.g. Schleicher & Schuell pyrogen free)
-Sterile trace element free 100 ml Nalgene bottles (for ICP-MS and ICP-AES analysis)
-Droplet bottles made of teflon FEP (fluorinated ethylene propylene)
-100 ml hardened plastic bottles for mercury analysis

Equipment to be purchased by each participant:

-Potassium dichromate solution for Hg preservation:
0.2 g of K2Cr2O7 (Pro analysis, PA, quality) / 100 ml nitric acid HNO3 (Suprapure quality)
-pH-meter (e.g. WtW pH90 or comparable)
-EC-meter (e.g. WtW LF92 or comparable)
-Buffer solutions for calibration of pH-meters
-Distilled and deionized water and a washing bottle
-Concentrated HNO3 65%, density 1.40 kg/l (Merck Suprapur (R) 100441 or equivalent)
-Permanent drawing ink markers
-Cool boxes and batteries for them
-Maps (topographical maps, preferred scale 1:50 000)
-Rubbish bags
-2 polyethylene (1 L) decanters for sample water to measure pH and EC
-Plastic 100 ml measuring cylinder (for alkalinity measurements, methods A and B)
-250 ml plastic conical flask (for alkalinity measurements, methods A and B)
If alkalinity is measured using method A (see below)
-Hach Model 16900-01 digital titrator or equivalent with solution delivery straws
If alkalinity is measured using method B (see below)
-1.6 N H2SO4: Dilute 44.4 ml of concentrated H2SO4 (mass-% = 96, density = 1840 g/l) to 1000 ml with deionized water.
-0.16 N H2SO4: Dilute 10 ml of 1.6 N H2SO4 to 100 ml with deionized water.
-Burette or equivalent equipment, 10 ml capacity, graduated in divisions of 0.02 ml
-Disposable Pasteur-pipettes

Water sampling procedure

Avoid sampling during rainy periods and flood events. The water sample must be taken before the stream sediment sample. The stream sediment sample is composited from 5-10 subsamples in the field. The water sample should be taken from the first, lowermost stream sediment sampling point. Water samples to be taken in the manner described below:

1. Write the sample number on bottles.
2. Complete sample card and mark your posititon and sample number on the map.
3. Rinse twice and fill the polyethylene decanters with stream water, place the electrodes in water and measure the pH and conductivity with calibrated meter (mark with permanent drawing ink marker two decanters for pH and conductivity).
4. Filter one 100 ml sample

-Put vinyl gloves on your hands
-Rinse a disposable syringe with sample water and fill it up with water
-Put filter on syringe
-Discard the first 10 ml of filtered water from each new filter unit used
-Take a 100 ml marked sample bottle for acidified sample and rinse the bottle twice with filtered sample water

-Fill the bottle up to its neck with filtered water (change filter if needed) and close it tightly. Note that the filtered sample water should go straight into the bottle without contact with your hands
-Take 60 ml marked sample bottle for DOC sample and rinse it twice with filtered sample water
-Fill the DOC sample bottle up to its neck with filtered water (change filter if needed) and close the bottle tightly.
-Note that the samplers are not allowed to smoke, or have the vehicle running, when the water sample is taken.
5. Rinse the marked 500 ml sample bottle with sample water twice and fill it up so that the bottle is completely submerged in the water and no air bubbles are left in the bottle. Fill the bottle as full as you can and close it tightly below water level.
6. Rinse the marked Hg sample bottle with sample water twice and fill it to its neck and close it tightly.
7. Note the pH - (with 1 decimal figure) and EC value (mS/m) on the field observation sheet. Rinse the electrodes and decanters with distilled and deionized water and keep the electrodes in their measuring decanters until all daily sampling sites are visited. Then place the meters in their cases. The meters are calibrated every day before the first measurements are taken.
8. Total alkalinity measurements – titration. Method (A): Using Hach digital titrator and standard acid cartridges. Method (B): Using normal burette and non standard acid.
9. The filled sample bottles are placed in the cool box.
10. After every 20th sample (and at least once in every country) the blank water sample is filtered: Filter distilled and deionized water in 60 ml bottle in the same manner as the normal water sample.

Treatment of water samples

1. In laboratory or in comparable conditions, soon after sampling (at least on the same day) add to the 100 ml filtered water sample bottle 1.0 ml of conc. HNO_3 acid with a droplet bottle. Use disposable clean vinyl gloves, because the acid is very corrosive. Do not let the droplet bottle touch the sample water in the bottle. Close the bottle tightly and shake it in order to get the acid well mixed with the water. Do not add acid to the 60 ml DOC sample bottle!
2. Add nitric acid and potassium dichromate to water samples in Hg sample bottle: 5 ml HNO_3- $K_2Cr_2O_7$ to 100 ml water bottle.
3. Place the bottles in a cool unit, e.g. refrigerator.
4. Send water samples to the laboratory soon after sampling.

Field observation sheet

FOREGS GEOCHEMICAL BASELINE PROGRAMME **STREAM WATER+STREAM SEDIMENT**

WATER SAMPLE ID _____ Date _____ Sampler _____
STREAM SEDIMENT ID_____ Country _____
Organisation _____
GTN cell coordinator if different from above _____

SAMPLE SITE LOCATION REGION _____ MAP SHEET _____
COORDINATES **(Decimal degrees mandatory)**
National grid Easting _____ Northing _____
Decimal degrees Longitude _____ Latitude _____ Datum _____
Altitude (m) _____
SITE DESCRIPTION
Approximate size of catchment basin _____ km^2
Landscape / topography_____
Land use
□ Agriculture, specify crop _____
□ Pasture, grassland, fallow field
□ Forest: □ Deciduous □ Coniferous □ Mixed
□ Wetland
□ Non-cultivated, moorland etc.
□ Other, specify _____
Bedrock lithology _____ Outcrops □ Yes, specify _____

□ No outcrops
Type of overburden _____
Channel charasteristics □ Natural □ Reinforced □ Man-made (ditch)
Last rainfall before _____ days _____ hours
Water level in stream: □ Low □ Normal □ High
Stream flow: □ Low □ Moderate □ High
Stream bed: Predominant □ Boulders and gravel □ Gravel and sand
□ Sand and silt □ Mud □ Vegetation
Possible sources of contamination, specify _____
NUMBER OF SUBSITES (stream sediment) _____
NUMBER OF SAMPLE BAGS (stream sediment) _____
PHOTOS Film and photo ID
Landscape _____
Site _____
GAMMA-RADIATION Total _____ Th _____ U _____ K _____
Instrument _____
WATER CHEMISTRY Normal sample Duplicate sample Instrument
pH _____ _____ _____
EC mS/m 25°C _____ _____ _____
DRYING (Sediment) □ Freeze drying □ <40°C

III.2 Sediment

III.2.1. Which type(s) of sediment do you sample/measure **bottom**, **suspended**, **floodplain**?
III.2.2. Sampling design strategy. How do you choose sampling locations?
How do you decide about temporal frequency of collecting samples?
III.2.3. Which parameters of sediment **quality**/**quantity** are measured ***in situ***?

III.2.4. Which appropriate sampling devices (e.g. GRAIFER, CAROTIER etc.) and instruments are used for ***in situ*** measurements (include manufacturer and type)?
III.2.5. Please, describe **methodology** for ***in situ*** measurements.
III.2.6. Which **tools** are used for collecting samples for **laboratory** measurements (include manufacturer and type)?
III.2.7. Please, describe a **methodology** for collecting samples for **laboratory** measurements.
III.2.8. Please, describe a **transport** methodology for samples intended for laboratory measurements.
III.2.9. Do you **archive** samples? If yes, please describe how.

Geochemical Mapping Programme (SGIDS)

Geochemical mapping, 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. Stream sediment, i.e. fine-grained sediment accumulated under favourable conditions in channels of surface streams - brooks and rivers under Slovakia's natural conditions (mainly Slovakia‘s variegated and lithofacially—spatially variable geological structure, relatively rugged topography, roughly equal intensity of chemical and mechanical weathering, etc.) is presumably the most important geological medium for environmental geochemical mapping. With regard to its history, stream sediments reflect, on the one hand, the composition of geological material from parent rocks and soils and on the other hand, thanks to their high accumulation capacity, they concentrate elements and substances from percolating groundwater and from flowing surface water. The average density of watercourses in Slovakia is 0.88 $km.km^{-2}$. In extensive lowlands, notably in the Danube lowland, and in areas underlain by highly permeable karstified Mesozoic limestones the density is as little as 0.1 $km.km^{-2}$.
Each collected sample is stored in a separate polyethylene bag. Where its 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. Where it was impossible to collect the sufficient amount of the clay fraction, the sample, up to 5 kg in weight, was collected over a distance of up to 100 m along the stream. Each collected stream sediment sample had its label with sample site identification. The site identification comprised a field number derived from the map sheet (at a scale of 50,000), a laboratory analytical number of sample in ascending order from 1 in order of reception and registration of the sample in the laboratory, the name of the organization and worker that collected the sample and the date of sampling. The geological data on the label included the character of the sediments (clayey, sandy, etc.), description of the presence and character of contamination by human activities, topographic site description and a description of the character of the rock environment in the sample site.

SEDIMENT SAMPLING (Water Research Institute WRI – VÚVH)

Devices and devices used for collection

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.
Electric motor (drive the boat).
Electricity source (car battery for driving the boat).
Boat (if not available from water tank manager).
Thermometer (metrologically verified).
Glass and plastic bottles (use according to laboratory instructions).
Echo-sounder with acoustic indication.
Cooling boxes (electric).
Surface and groundwater workers take samples of bottom sediments from water basins used for recreation or drinking water supplies. Due to the nature of the work and the safety of work in the field, there are at least 2 employees. Workers are required to use the prescribed protective working tools when ordering and to comply with the regulations and guidelines for health and safety at work.

PRINCIPLE OF THE METHOD

Simple (point) sample

Obtain a simple (point) sample of bottom sediments to determine their composition at a specific time at a specific location. The sampling device must not cause contamination of the samples. Consequently, the transfer of sampled material between individual subscriptions should be avoided.
The type of collection device used is selected with respect to the depth of water and, in particular, depending on the purpose of the collection. At depths of water up to approx. 5 m it is possible to use the UWITEC nuclear excavator with a telescopic rod and manual pressing into the sediment, at the larger depths we use the gravity separator UWITEC with a junction or a pick-up with the possibility of casting. The sampling is carried out from the same layer or thickness of the sediment. The components of one sample are taken using the same device.

Mixed sample

According to the intent of the survey and to exclude the controversial results and to determine the average state with regard to spatial inhomogeneity, it is possible to prepare a mixed sample. The mixed sample consists of two and more simple (point) samples and can be prepared as follows:
individual single samples are homogenized;
From each sample, equal volumes are collected, combined and homogenized.
The mixed sample may not be composed of samples taken from the bottom of a different character. When sampled with a core tube, the core length of all samples must be the same for obtaining the mixed sample.
The sampling is carried out in the same way as for simple samples, with the sampling plan taking a determined number of sample samples of the same volume and then homogenising the mixed sample. In order to produce mixed samples taken from the core tube, the core length of all samples must be the same for the mixed sample.

Place of collection

The sampling site is determined according to the processed sampling program, or based on customer requirements. If the sampling site is not established, samples shall be taken at the point where the maximum sampling objectivity can be ensured.

Handling of collected samples

After the sampling is collected, it is placed directly in the field in the appropriate bottle (glass or plastic). The choice of the bottle, which are marked with a permanent label to withstand damage during collection and transport, is governed by the scope and needs of follow-up analytical procedures. During transport, the sample in the

bottle is stored in the refrigerator box (electric) or in the refrigerator. in an isothermal box. Requirements for the type of sampler, other important information is consulted with the laboratory to perform the analysis.

Field measurements

Local meteorological conditions (cloudiness, rainfall, coldnesss etc.) are recorded.

Records of subscriptions made

At each sampling of bottom sediment, the workers shall record the sampling in the sampling record and in the protocol.

Maintenance and Washing

Used devices and aids should be flushed with sufficient amount of clean water, especially for this purpose, after the collection has been completed. If the sample is soiled with oil or water, it is cleaned with detergent and water and then thoroughly rinsed with clean water.

Sample sedimentation of bottom sediments

Wet sediment samples are processed prior to their analysis in laboratory by means of a sieving device with required mesh size (63 μm mesh size). After removing the sample from the refrigerator, excess water is poured out of the sampler. The sample is homogenized by mixing directly in the storage bottle.

Depending on the appearance of the homogenized sample, the size of the weight to be sieving is determined. Based on the mechanical properties of the used sieve (63 μm mesh size) used for sediment treatment, the net sample weight of the sample is between 10 and 80 g. After the laboratory sieve has been set up in the sieve and the sieve sediment sample is placed, the sieving device is safely closed and put into operation. The sessions are determined based on the nature of the sample, a range of 30 to 90 minutes is appropriate. Upon completion of the sieving, remove the residue of the excess fraction of the sample not passing through the sieve and again add the new weight of the sample to be sifted. We repeat this step several times until we have enough sample (fraction less than 63 μm mesh size).

Preset the presumed samples quantitatively into the centrifuge cells that we insert into the centrifuge. Depending on the nature of the sample, we set the spin speed and spin time. Suitable revolutions are 6000 RPM and spin time is 30 minutes.

After centrifuging, we remove excess water and quantitatively transfer the solid sample to the Petri dish and allow to dry freely at room temperature.

We crush the dried sample in the mortar on a very fine powder, which we place in the labeled bottle supplied by the laboratory, which will perform the analysis of the treated sediment.

Geochemical Atlas of Europe. Part 1 - Background Information, Methodology and Maps

Slovakia participated on the project „Geochemical Atlas of Europe. Part 1 - Background Information, Methodology and Maps“. A precised and detailed sampling strategy was established and FOREGS GEOCHEMICAL MAPPING FIELD MANUAL was created. Details see:

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

The majority of stream sediment surveys have been based on the collection of <0.200 mm material. The IGCP 259 and FOREGS standard sieve mesh is <0.150 mm as this

is fine enough to only include the very fine sand, silt, clay and colloidal fractions, but is coarse enough to yield sufficient fine material in the majority of situations.
Studies in the UK have shown the recovery of stream sediments by dry sieving methods is not quantitative owing to the agglomeration of fine material to form larger particles which are then screened out in varying amounts. A system of wet sieving stream sediments wherever possible is therefore recommended for IGCP 259/360 and FOREGS.
It is important to avoid metal contamination at every stage of sampling as follows.
No hand jewellery or medical dressings should be worn during sampling. If medical dressings are worn, heavy duty rubber gloves must be worn at all times to avoid contamination of the samples. Metal free polyethylene or unpainted wooden spades/scoops should be used. Metal free nylon sieve-mesh housed in inert wooden or metal free plastic frames should be used. Metal free funnels and sample collection containers should be used.
If it is not possible to use non-metal equipment (e.g. spades and sieve frames), unpainted steel equipment should be used. Aluminium and brass equipment should be avoided.
Dry sieveing is an alternative method if wet sieving cannot be used, as is the case of seasonal streams in Mediterranean countries.

Stream sediment samples to be collected

Each stream sediment sample comprises material taken from 5-10 points over a stream stretch of 250 - 500 m. Stream sediment sampling should start from the water sampling point and the other sub-samples should be collected up stream. A composite sample should not be made from samples taken from beds of different nature (ISO 5667-12:1995). From one small catchment basin of a duplicate cell (one in each country) minimum 0.5 kg (dry weight) + 0.5 kg (duplicate sample) of <0.150 mm material is required. From all other small catchment basins a minimum of 0.5 kg (dry weight) <0.150 mm material is required.

Equipment to be provided by regional laboratories:

-Kraft paper bags
-Polyethylene bags

Equipment to be purchased by each participant:

-Heavy duty elbow length rubber gloves
-Metal free polyethylene funnel
-Sieve set with 2 preferably wooden or plastic frames containing nylon 2.0 mm mesh and nylon 0.150 mm mesh screens
-Metal free gold pan or plastic bucket
-Metal free plastic crates
-Metal free plastic buckets or containers with lids
-Trenching tool - metal free, polyethylene (PE) or polypropylene (PP)
-Permanent drawing ink marker (preferably black or blue)
-Permanent ink pen
-Maps (topographical maps, preferred scale 1:50 000)
-Chisel-end geological hammer for dry areas (e.g. Mediterranean countries)
-Bristle brush (dry sediment samples)

Sampling procedure

Mark the sample identifier on the Kraft paper bag using permanent ink marker. Mark the exact site location of the first and last subsamples on the field map by means of a small lines perpendicular to the stream flow. Complete the details of the field observation sheet.

Wet sieving is recommended whenever it is possible. If it is not possible to wet sieve the stream sediment sample in the field, the collected stream sediment material should be dry sieved.

Sampling and wet sieving

Once the site for sampling has been selected, mark the exact location of the first and last sampling points on the field map by means of a small line perpendicular to the stream flow using the ink pen. Mark the sample identifier number on map next to the sampling location. Complete the details on the field observation sheet. Write the sample identifier on the collection bucket and lid using the permanent drawing ink marker.

Rubber gloves are recommended for protection throughout sampling.

Following collection of any water samples, prepare the equipment for stream sediment sampling:

-Wash all stream sediment sampling equipment (buckets, sieves, gold pans, funnel, gloves and spade) with stream water.

-Set-up the gold pan or collection bucket in a stable position (since material will be collected from 5-10 points over a distance of 250-500 m, it is recommended that the sieving site is located at the half-way point).

-Place the sieve with the 0.150 mm aperture nylon cloth in a stable position resting on the gold pan or bucket.

-Place the sieve with the 2 mm aperture nylon cloth over the 0.150 mm sieve.

-It is important that the sieve frames fit closely over the collection pan or bucket to avoid loss of material over the edge of the bucket.

-In rugged terrain, where collapse of bank material into the channel is common, sediment from as near the centre of the stream as possible should be collected to avoid sampling bank-slip material.

-In areas of low relief, active stream sediment in the centre of channels may be enriched in quartz and depleted in clays and other fine particles. In these instances material deposited along stream margins during flood events may be finer grained and more suitable for geochemical sampling.

-Load equal amounts of coarse active sediment from 5 - 10 points on the stream into plastic buckets taking care to drain off excess water.

-Enough coarse grained material should be collected to yield a minimum of 0.5 kg <0.150 mm material (dry weight).

The amount of coarse material required will vary substantially depending on the underlying geology and terrain. Geochemists should use their knowledge and judgement to assess how much coarse material will be required.

-Mix the buckets of the coarse sediment thoroughly with the plastic stirring rod and carry them to the sieving location

-Load sediment into the top sieve with the spade. If more than one bucket of coarse sediment has been collected, equal amounts of sediment should be loaded into the sieve from each bucket in turn.

-Rub the material through the top sieve wearing rubber gloves for protection.

-Take care to remove large stones from the sediment by hand.

-Once the bottom sieve contains a reasonable quantity of <2 mm sediment, remove the top sieve and discard the >2 mm material.

-The <2 mm sediment in the bottom sieve is washed and rubbed through the sieve with the aid of water and shaken down.

-It is very important at this stage that coarse material which would bias the sample does not enter the collection bucket. This may be avoided by carefully washing the outside of the bottom sieve prior to shaking.
-In order to enhance the trace element signature, it is important that all the <0.150 mm material is collected, therefore, a minimum amount of water should be used to wash the sediment through the bottom sieve and all washing water should be retained in the collection bucket until the sample is allowed to settle.
-The sample should be repeatedly washed and shaken down until all the fine material has passed through the sieve.
-The whole sieving process should be repeated until the bucket contains sufficient fine grained wet sediment to yield 0.5 kg dry weight material.
-If sediment is collected in a gold pan, it should be transferred to a collection bucket with lid for transporting to the field base.
-Once enough wet sediment has been collected, secure the lid on the bucket. The sediment should be carefully transported to the field base and allowed to stand for at least 45 minutes or until all the suspended material has settled and clear water sits on top of the sediment.
-Once the suspended material has settled, excess water on the surface of the sediment should be carefully decanted. Care should be taken to remove only water and not sediment at this stage.
-The remaining sediment should be thoroughly homogenised and mixed using the plastic stirring rod before being transferred into sample bags.
-Using the permanent ink marker pen, write the sample identifier on enough 10 x 22 cm Kraft paper bags to hold all the sample volume. This size of Kraft bag allows ease of drying the samples.
-The number of bags for each sample site should be recorded on the field sheet and on a sample check-list sheet.
-Once the sample has been homogenized, carefully transfer the sample into the Kraft bags using a clean plastic funnel.
-The Kraft bags should be hung out to air dry at the field base for as long as possible.
-When moving the samples, place each Kraft bag in a 15 x 40 cm polythene bag and secure the top of the bag with a knot to prevent loss or cross contamination of samples during transport.
-The samples should be secured upright in a plastic crate or box and transported carefully to the next location or to the Survey base for further drying.
-At the Survey base or laboratory, the samples should be completely dried at < 40oC. Freeze drying is a recommended as this helps to disaggregate the samples.
Dried samples should be sent to LAB I.
All sampling equipment must be thoroughly cleaned between each site to avoid cross contamination.

Sampling and dry sieving

The procedure for the selection of sample sites, recording their location on the field map, completion of field observation sheets, wearing of rubber gloves, etc. are the same as for the wet sieving sampling method.
Since, water is not available to wet sieve the stream sediment to the required <0.150 mm fraction, collect a bulk composite sample from 5-10 points over adistance of 250-500 meters. The total dry weight of the composite sample (free of stones and other coarse grained material) should be about 5 kg to ensure that the required amount of 500 grams of analytical <0.150 mm material will be obtained after sieving at the domestic lab.

Collect material of finer grain size (or if possible only the top thin layer of silt on the sand bar) from the centre of the stream. Care should be taken to sample stream sediment with as little as possible organic matter, and to avoid the reduced material (mostly dark colour and bad smelling), which occurs at greater depths. Also, in the case of narrow channels take care not to collect material which has fallen from the banks.

The removal of stones and other coarse grained material could be achived by sieving through a 5 mm nylon sieve, and collecting the material in a plastic bowl. Collect equal amounts of material from the 5-10 subsites. The use of the 2 mm nylon sieve is not recommeded for dry sieving, because it is too small for clay agglomerates and slightly moist samples.

Transfer the fine grained sample to the Kraft paper bag and seal. Place the sealed Kraft envelope within a polyethylene bag, and tie a loose knot in the polyethylene bag to prevent loss or cross contamination during transportation.

A special case is the sampling of small seasonal streams in Mediterranean countries, which must be sampled with extreme care. Some of the seasonal streams have had no water flow for many years, and the stream bed may be covered by fallen bank material in which grass or other plants may have grown.

Since, active stream sediment must be sampled, the fallen bank material, covering the "old" active stream sediment, must be removed by digging before taking the sample at each subsite. The pits should be dug near to the centre of the channel.

Air dry the sample, disaggregate if necessary in porcelain bowl and sieve it through a 2 mm aperture nylon sieve in the domestic lab before shipping to the LAB I.

Photographing

At each stream sediment/water sample site take two photographs, the first to show general upstream topography from the lowermost subsite and the second the nature of the stream bed at the best subsite.

Identifiers

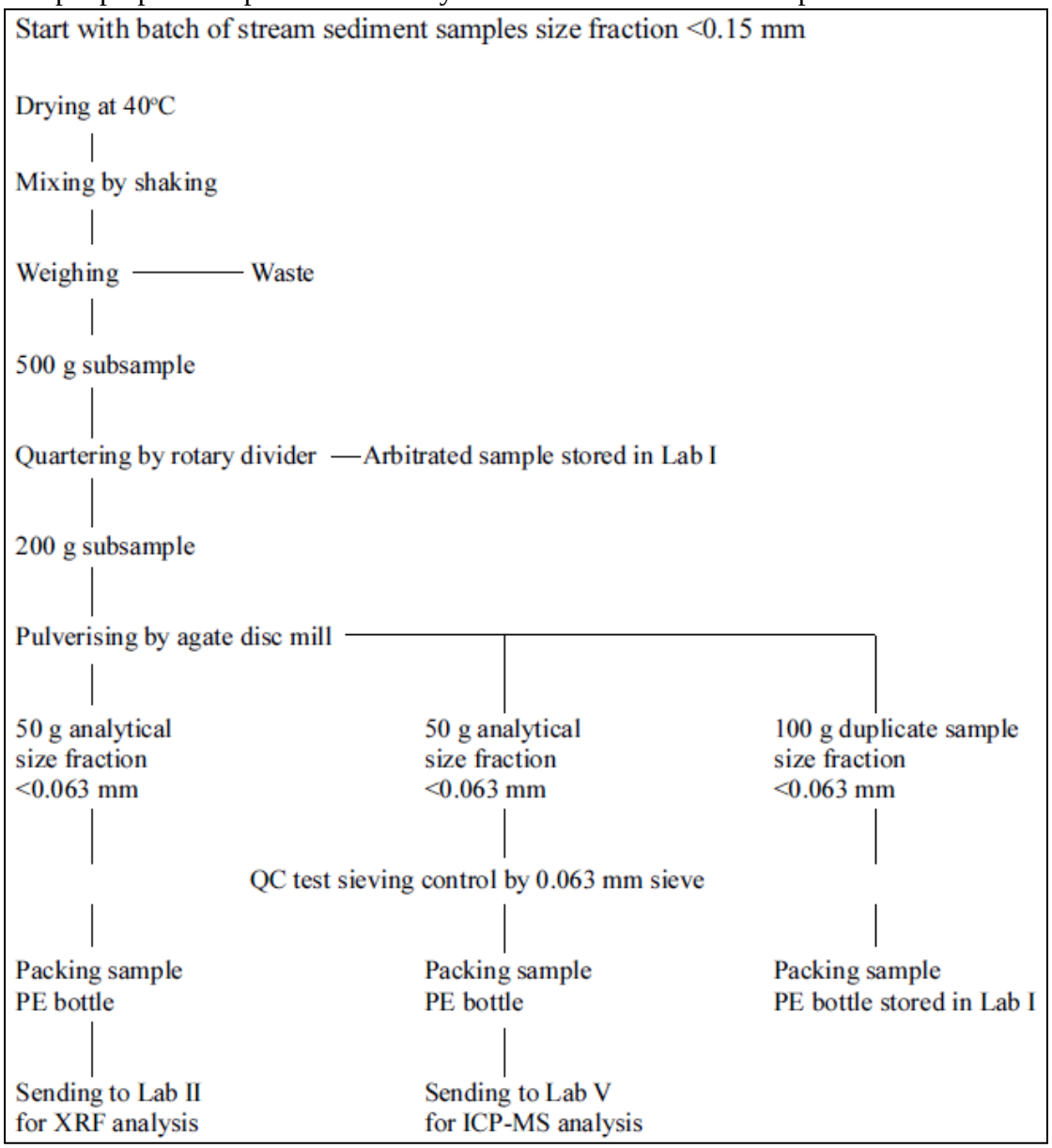
The following example clarifies the sample identification system. The identifier of the stream sediment sample may be:

N43E09S4, where N43E09 = GTN cell, S = Sample medium symbol, 4 = Catchment (drainage) basin number.

The duplicate sample would be N43E09S4D, where D is the duplicate sample identifier. Identifiers for filtered blank (or zero) water samples are:

GTN cell / W / Catchment basin number / 0 (zero), for example N43E09W40.

Sample preparation procedure for dry sieved stream sediment samples



Floodplain sediments

A floodplain sediment, representing the alluvium of the whole drainage basin will be collected from the alluvial plain at the lowermost point (near to the mouth) of the large catchment basin (1000 – 6000 km2).

Both floodplain and overbank sediments are finegrained (silty-clay, clayey-silt) alluvial soils of large and small floodplains respectively, according to the size distinction made by Darnley et al. (1995).

Floodplain and overbank sediments are deposited during flood events in low energy environments (Ottesen et al., 1989); they should, therefore, be devoid of pebbles, which indicate medium energy environments.

The surficial floodplain and overbank sediments are normally affected by recent anthropogenic activities, and may be contaminated. Deeper samples, which are optional sample media, normally show the natural background variation.

Floodplain sediment samples to be taken

From the first sampling site of a duplicate cell (one in each country) collect:
- 2 kg of top floodplain sediment + 2 kg of top floodplain sediment (duplicate sample)
From all other sampling sites collect:
- 2 kg of top floodplain sediment
Enough material must be taken to yield minimum 0.5 kg of <2 mm grain size sediment. Larger sample quantities can be taken and stored separately in each country.
OPTIONAL:
From one sampling site of a duplicate cell 2 kg of bottom floodplain sediment + 2 kg of bottom floodplain sediment (duplicate sample) and from all other sampling sites 2 kg of bottom floodplain sediment.
Residual soil type of the small (< 100 km2) catchment basin, it must be a residual or sedentary soil, but definitely not an alluvial soil. Each sample should be a field composite sample from 3 - 5 subsamples in the field. Minimum distance between any two subsamples should be 5 m. Avoid sampling adjacent to roads (minimum distance 10 m) or ditches (minimum distance 5 m), but you are free to use your discretion depending on the traffic density and prevailing local conditions.
Living surface vegetation, fresh litter, big roots and rock fragments (stones) are removed. In case the whole soil profile does not reach a depth of 75 cm, the lower sample should be taken from a depth, that can be undoubtely identified as the BC or C-horizon (do not forget to note this down under remarks on the field observation sheet!). If this is not possible another sample site should be selected.
The subsoil sample is taken first, and then the topsoil sample. This procedure avoids cleaning the surface of the subsoil from fallen top soil, if the latter is taken first.
After collection of each sample clean thoroughly the sampling equipment.
Photographing
At each humus sample site take two photographs; the first to show the general topography of the tree layer and undergrowth, and the second a close-up to show the character of the organic layer. A flash may be necessary for the second photograph. If the humus samples and residual soil samples are collected from the same site, the close-up photo can show both the character of organic layer and mineral soil horizons (see below). In this case, separate photographs for the soil sample site will not be needed.
At each soil sample site two photographs should be taken; the first to show the general view about the sampling site (Fig. 9), and the second a close-up of one of the soil sample pits (Fig. 10). Before taking the second photograph mark with a knife the soil horizons, if they can be distinguished, and place an alternate coloured-section wooden metre as a scale on the face of the pit. If necessary use a fill-in flash when taking the second photograph, because it is
Equipment to be provided by regional laboratories
- Kraft bags for floodplain sediment
- Disposable gloves (1 per sample)
Equipment to be purchased by each participant
- Unpainted spade
- Pickaxe
- Knife
- Plastic or steel scoop
- Chisel-end geological hammer
- Wooden folded 2 m long metre
- Permanent drawing ink marker
- Maps (topographical maps, preferred scale 1:50000)

- Plastic boxes for sample bags
- Kraft paper bags for overbank sediments (optional)

Field observation sheets for floodplain sediments and the optional overbank sediments are included in this manual (see Appendix 1).

Sampling tools should be made of unpainted wood, polyethylene (plastic) or steel (unpainted spade).

Containers should be made of paper or strong polyethylene.

Sampling procedure

Study the floodplain sediment sequence to begin with, and select a suitable section with many layers of fine-grained material, e.g. silty-clay, clayey silt, deposited in a low energy environment. Pebbles in fine-grained material, and gravel beds indicate medium to high energy environments, respectively.

Avoid sites adjacent to roads or ditches (minimum distance 10 m). Mark the sampling site on the field map and complete the general field observations on the card, leaving the grain size to be completed after the sampling.

Two different depth related samples may be taken at each site:

MANDATORY: a top floodplain sediment sample from 0-25 cm (excluding humus where present and surface litter), and OPTIONAL: a bottom floodplain sediment sample from the very bottom layer (lowermost 25 cm) of the exposed section, just above the water level of the river; note the depth of the sample interval on the field observations sheet.

FOREGS laboratories will not provide analyses of the optional sediment samples.

In both cases single floodplain sediment layers must be sampled. If the thickness of the top floodplain sediment layer is less than 25 centimetres, do note its thickness on the field observation sheet, and the number of layers sampled. The optional deep sample should ideally be collected immediately above the gravel bed (Fig. 5). Since, this is not always possible, the deepest possible layer should be sampled, for the objective is to reach a layer, which is not affected by human activities.

The floodplain sediment and optional overbank sediment samples are collected from a single site (Figs. 11 and 12).

At each exposed floodplain sediment sample site clear the surface humus and litter to begin with, and then cut a vertical section through the exposed floodplain sediment sequence with a steel spade, thus exposing a clean vertical surface for sampling. If you collect both top and bottom samples, sample the bottom layer first at each sample site, and then the top layer. This procedure avoids cleaning the surface of the bottom layer from fallen top sample material, if the latter is taken first.

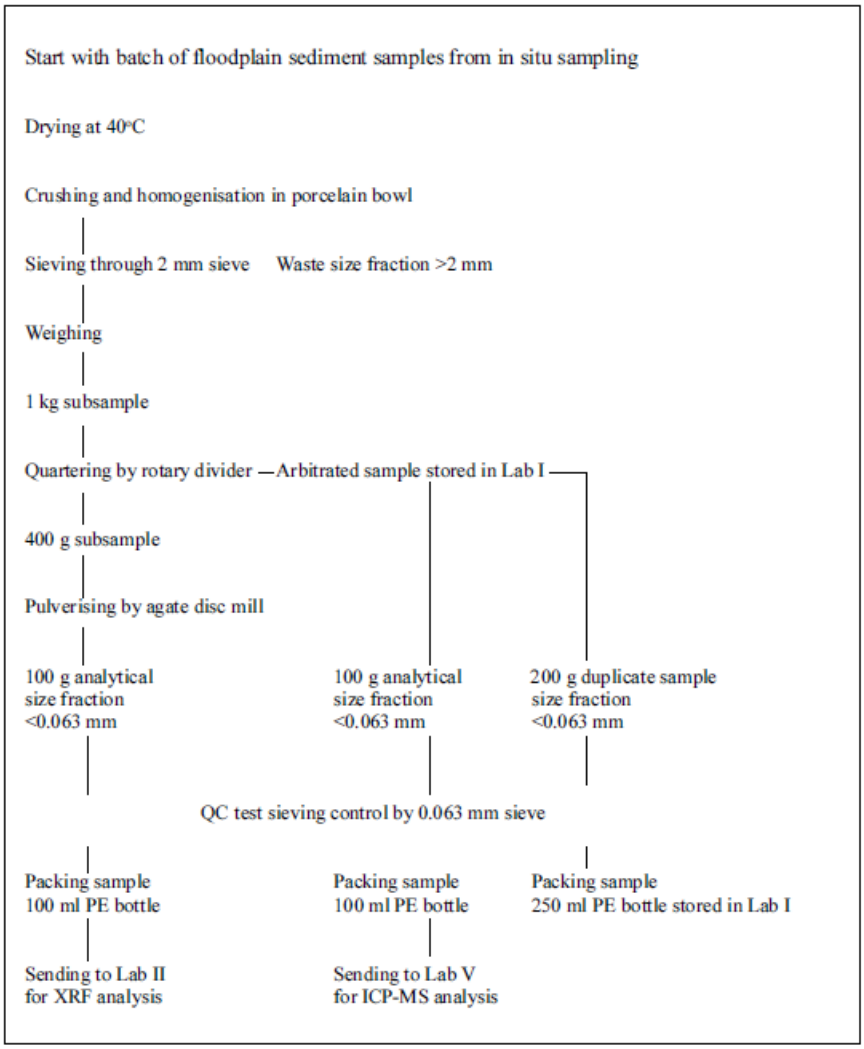
If it is not possible to sample an exposed floodplain sediment sequence with the aid of a spade, follow the same procedure to select a suitable sample site on the floodplain (e.g., inside meander) and dig a pit down to the required depth.

Living surface vegetation, fresh litter and big roots are removed by wearing plastic gloves.

After the collection of each sample clean thoroughly the sampling equipment.

Photographing

At each floodplain (and overbank) sediment site two photographs should be taken, the first to show the general view about the sampling site with reference to the stream/river channel and the second a close-up of the sample pit. Before taking the second photograph mark with a knife the alluvial sediment layers, if they can be distinguished, and place an alternate coloured-section wooden metre on the face of the pit. If necessary use a fill-in flash when taking the second photograph, for it is important to show the layers and textural charasteristics of the alluvial beds.



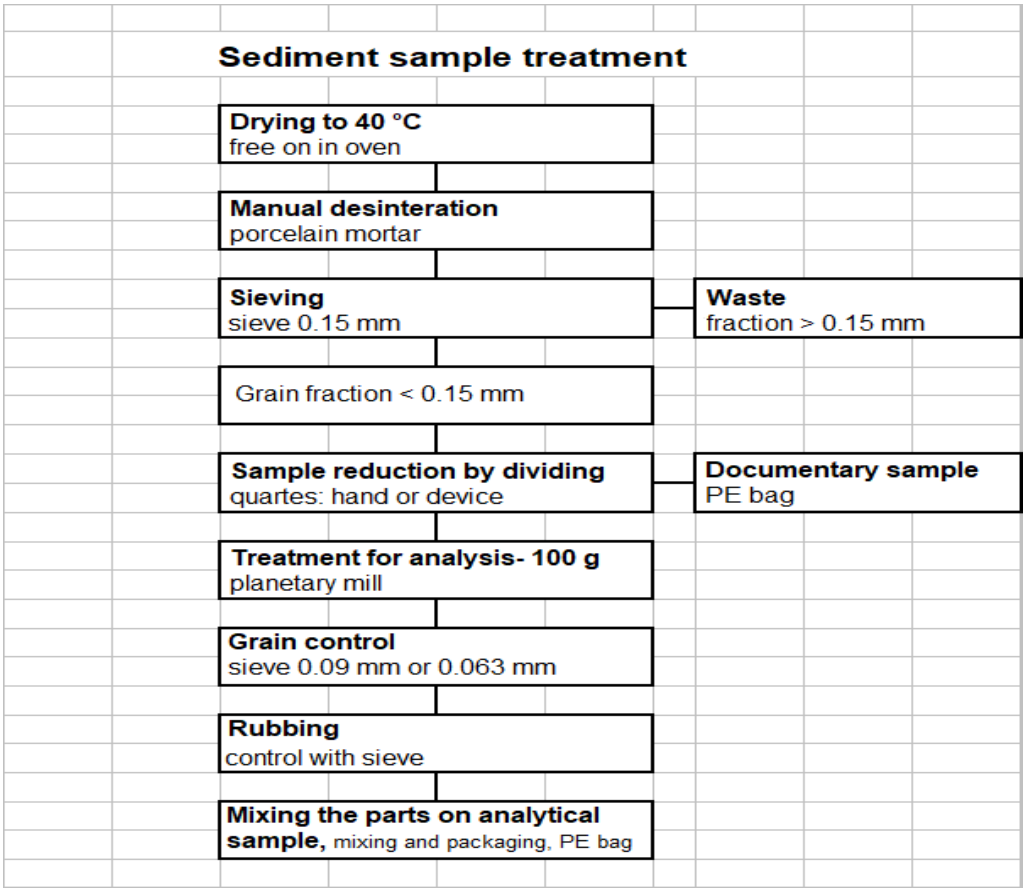
IV.INVENTORY OF LABORATORY METHODOLOGIES

IV.1. How do you **mechanically prepare samples** for measurement (drying, sieving, grinding, homogenization, etc.)?

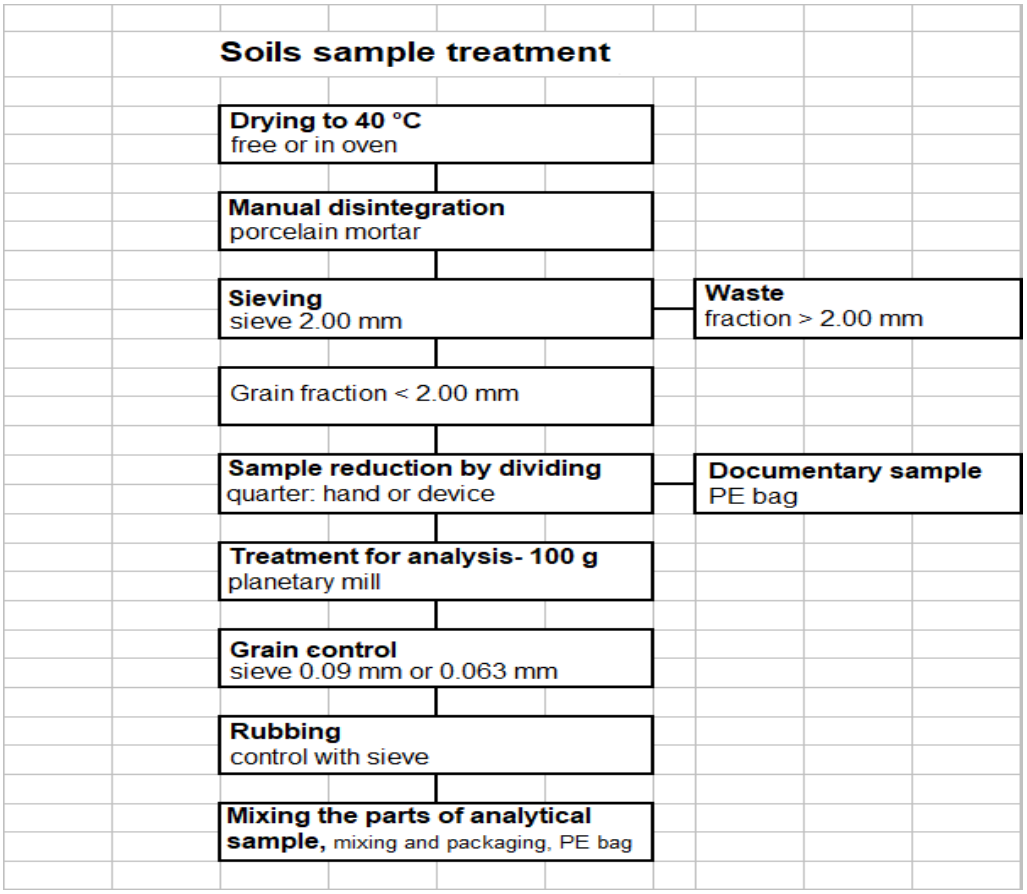
a) water
b) sediment
c) biota?

b)sediment and soils

Sediment sample treatment



Soils sample treatment



c)biota
PLANT SAMPLE: 1. If it is possible, in the case of sampling of fresh produce, 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 ...), the archive sample is stored in the freezer box.

IV.2 Chemicals.

Granulometric analysis (information on the correlation of particle sizes and the absorption of toxic metals or metal compounds in sediments).
Analytical methods (including sample preparation: e.g. acid digestion, etc.) for the hazardous substance analyzed in agreement with the matrix in which it is being analyzed (water, sediment, sludge).
Type of analytical equipments.
Description of internal procedures

IV.2.1. Organic matter. What is the **procedure** for **organic matter** content determination in water and sediment?

IV.2.2. ICP-MS, ICP-AES systems
IV.2.2.1. Which system of analysis do you use (ICP-MS, ICP-AES, etc.)? Please, include manufacturer and type.

ICP-AES	ICP-OES 5100 Agilent
ICP-AES	ICP-OES 5110 Agilent
ICP-MS	ICP-MS Aurora M90 Bruker
ICP-MS	ICP-MS Agilent 7900

IV.2.2.2. Which **elements (HSs)** do you measure by this system? Please, state **detection limits** for measured elements (HSs).

Table Elements in water measured by ICP-OES 5110

Analyte	LOD	Unit
Ag	0,245	□g.l^{-1}
Al	0,001	mg.l^{-1}
B	0,005	mg.l^{-1}
Ba	0,0002	mg.l^{-1}
Be	0,031	□g.l^{-1}
Ca	0,0299	mg.l^{-1}
Cd	0,100	□g.l^{-1}
Co	0,521	□g.l^{-1}
Cr	0,536	□g.l^{-1}
Cu	0,582	□g.l^{-1}

Analyte	LOD	Unit
Fe	0,0004	$mg.l^{-1}$
K	0,0395	$mg.l^{-1}$
Mg	0,0224	$mg.l^{-1}$
Mn	0,00016	$mg.l^{-1}$
Mo	0,679	$\mu g.l^{-1}$
Na	0,0205	$mg.l^{-1}$
Ni	0,622	$\mu g.l^{-1}$
Pb	1,295	$\mu g.l^{-1}$
SiO_2	0,0101	$mg.l^{-1}$
Sn	4,665	$\mu g.l^{-1}$
Sr	0,00023	$mg.l^{-1}$
Th	0,198	$\mu g.l^{-1}$
Ti	0,00045	$mg.l^{-1}$
U	0,782	$\mu g.l^{-1}$
V	0,399	$\mu g.l^{-1}$
Zn	0,434	$\mu g.l^{-1}$

Table Elements in soils and sediments measured by ICP-MS Aurora M90 Brucker

Analyte	LOD	Unit
Dy	0,005	$mg.kg^{-1}$
Er	0,004	$mg.kg^{-1}$
Eu	0,006	$mg.kg^{-1}$
Gd	0,005	$mg.kg^{-1}$
Ho	0,003	$mg.kg^{-1}$
Lu	0,004	$mg.kg^{-1}$
Nd	0,015	$mg.kg^{-1}$
Pr	0,007	$mg.kg^{-1}$
Sm	0,009	$mg.kg^{-1}$
Tb	0,006	$mg.kg^{-1}$
Tm	0,004	$mg.kg^{-1}$
Yb	0,006	$mg.kg^{-1}$

Table Elements in water measured by ICP-MS Agilent 7900 or Aurora M90 Brucker

Analyte	LOD	Unit
Ag	0,17	$\mu g.l^{-1}$
As	0,10	$\mu g.l^{-1}$
Be	0,019	$\mu g.l^{-1}$
Bi	0,17	$\mu g.l^{-1}$
Cd	0,029	$\mu g.l^{-1}$
Co	0,096	$\mu g.l^{-1}$
Cr	0,12	$\mu g.l^{-1}$
Cu	0,24	$\mu g.l^{-1}$
Ga	0,03	$\mu g.l^{-1}$
Li	0,08	$\mu g.l^{-1}$
Mn	0,03	$\mu g.l^{-1}$
Mo	0,15	$\mu g.l^{-1}$

Analyte	LOD	Unit
Ni	0,21	□g.l^{-1}
P	1,4	□g.l^{-1}
Pb	0,07	□g.l^{-1}
Sb	0,042	□g.l^{-1}
Se	0,12	□g.l^{-1}
Sn	0,08	□g.l^{-1}
Te	0,12	□g.l^{-1}
Th	0,14	□g.l^{-1}
Tl	0,05	□g.l^{-1}
U	0,12	□g.l^{-1}
V	0,10	□g.l^{-1}
W	0,12	□g.l^{-1}
Zn	0,30	□g.l^{-1}

IV.2.2.3. Please, describe **sample preparation and procedure** for these measurements (microwave acid digestion, another disintegration procedure, gas velocity, temperature of atomization, mirrors position, nebulizer type, excitation power, wavelengths etc.).

→ **The sample of water** must be delivered to the laboratory as soon as it has been taken. Sampling and transport are performed according to STN ISO 5667.
→ The sample, if necessary, in annealed at 550°C for 1 hour in a platinum pot- usually be done for **samples of soils and sediments**. The sample is then decomposed with a mixture of acids (10 ml HF and 1 ml 70% $HClO_4$). After of addition of the acid mixture, the sample is thoroughly mixed and *evaporated from hot soak* until the white smoke is formed. Then 5ml of HF are added and the solution is evaporated to dryness. 2ml of $HClO_4$ are added and again evaporated to dryness. 5ml of HNO_3 are added to the residue, digested for 20 minutes with heat. After cooling, the solution is quantitatively transferred to a 50 ml volumetric flask with distilled water, made up to the mark and poured into a dried PE vial (stock solution). Elements are determined from the stock solution diluted 10 times. Simultaneously with sample set, a blank is also being prepared.

IV.2.2.4. How do you calculate **accuracy and precision** (references)?

Accuracy- calculated from the measured results of certified and internal reference materials or samples obtained by diluting one or more commercially available standard solutions of specified elements with a concentration of 1 mg.ml^{-1} or 10 mg.ml^{-1}.
Precision- was calculated as the relative standard deviation of the set of measured values of the verified component in the certified and internal reference materials, or samples obtained by diluting 1 mg.ml^{-1} or 10 mg.ml^{-1} of the single or multi-element commercially available standard solutions.

IV.2.3. AAS systems

IV.2.3.1. Please, state manufacturer and type of AAS(F-AAS,GF-AAS) instrument you use.

Mercury in Water	Mercury in Solids
AAS AMA- 254, Altec Prague	AAS AMA- 254, Altec Prague

IV.2.3.2. Which **elements (HSs)** do you measure by AAS? Please, state **detection limits** for measured elements (HSs).

Table Mercury in water

Analyte	**LOD [mg/l]**
Hg	0,00003

Table Mercury in solids

Analyte	**LOD [mg/kg]**
Hg	0,003

IV.2.3.3. Please, describe **sample preparation and procedure** for AAS measurements (dissolution, radiation source, source temperature, wavelengths, etc.).

- the solid geological material is dried at 40°C, homogenized to a particle size of 0.09 mm. Patterns whose content exceeds operating range 4 $mg.kg^{-1}$ are measured after the sample has been decomposed (0.1 g of the sample is added 15 ml of conc. HNO_3 and let it stand on the second day. From that stock solution, pipette 5 ml to a 50 ml volumetric flask, make up to volume with deionized water and dosed with micropipette into spectrometer (200 µl of sample))

- in sludge is measured directly, without sample processing. The content is converted to that state

- the plant material is dried at 40°C and homogenized, the plant sample is used in the solid state, no mineralization of the samples is required

- the water samples are fixed immediately after collection (0.5 ml of conc. HNO_3; 0.05 ml of 10% $K_2Cr_2O_7$ per 50 ml of sample) and stored in dark glass flask

IV.2.3.4. How do you calculate **accuracy and precision** (references)?

IV.2.4. XRF

IV.2.4.1. Please, state manufacturer and type of XRF(EDXRF,WDXRF) instrument you use.

Energy dispersive XRF (X-ray fluorescence) spectrometers – SPECTRO XEPOS

IV.2.4.2. Which **elements and/or compounds** (HSs) do you measure by **XRF**? Please, state **detection limits** for measured elements and/or compounds (HSs).

Table Major elements

Analyte	LOD [%]
SiO_2	0.015
Al_2O_3	0.015
Fe_2O_3	0.015
CaO	0.015
MgO	0.015
TiO_2	0.003
MnO	0.003
P_2O_5	0.003
Na_2O	0.06
K_2O	0.015

Table Minor elements

Analyte	LOD **[$mg.kg^{-1}$]**
As	0.3
Ba	3
Cd	0.3
Cl*	0.003
Cr	1.5
Cs	0.9
Cu	1.5
Ga	0.9
Ge	0.3
Mo	0.9

Analyte	LOD **[mg.kg^{-1}]**
Nb	0.6
Ni	1.2
Pb	1.5
Rb	0.6
Sb	0.6
Sn	0.6
Sr	0.6
Te	0.3
Th	0.9
U	0.9
V	1.5
Y	0.9
Zn	1.5
Zr	1.5

IV.2.4.3. Please, describe **preparation of the sample and procedure** for XRF measurements.

Sample preparation for geo-analytical samples:

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).

IV.2.4.4. How do you calculate **accuracy and precision** (references)?

IV.2.5 DC-arc –AES

IV.2.5.1. Please, state manufacturer and type of instrument you use (type of detectors etc.).
IV.2.5.2. Which **elements and/or compounds** (HSs) do you measure by **DC-arc-AES**? Please, state **detection limits** for measured elements and/or compounds (HSs).
IV.2.5.3. Please, describe **preparation of the sample and procedure** for DC-arc-AES measurements.
IV.2.5.4. How do you calculate **accuracy and precision** (references)?

IV.2.6. Radionuclides

IV.2.6.1. **Which instrumental method(s)** you use to detect radionuclides in water, sediment and/or biota? Please, state manufacturer and type of radionuclide detection instrument you use.
IV.2.6.2. **Which radionuclides** do you measure? Please, state **detection limits** for measured radionuclides.
IV.2.6.3. How do you calculate **accuracy and precision** (references)?

IV.2.7. Organic compounds (HSs)

IV.2.7.1. **Which instrumental method(s)** you use to detect organic compounds (HSs) in water, sediment and/or biota?

GC-FID	Agilent 7890B GC-FID Varian 3900 GC-FID
GC-ECD	Varian 450-GC GC-ECD
GC-MS	Agilent 7890B GC-MSD Agilent 597B GC-MS
GC-MS/MS	Agilent 7010B GC-MS Triple Quad
HPLC-DAD/FLD	Agilent Infinity 1260 HPLC-DAD/FLD
LC-MS/MS	Agilent 6470 LC/MS Triple Quad

Organic compounds by WRI-VÚVH:
PCB, PAU, …etc: pre-treatment extraction in extraction agent selected according to the type of analyte, then Gas Chromatography–Electron Capture Detector (GC-ECD)

or High-Performance Liquid Chromatography-UV detector (HPLC-UV) or Gas Chromatography-Mass Spectrometry (GC-MS)

IV.2.7.2. **Which organic compounds (HSs)** do you measure?

We measure wide range of organic compounds such as non-polar extractable substances (NES), VOC, BTEX, OCP, PCB, PAH, Pesticides, Acid herbicides, Aldehydes, Phthalates, Phenols, Pharmaceuticals, Hydroxy-s-triazines in water.

Please, state **detection limits** for measured organic compounds (HSs).

1. NES (GC-FID)

Analyte	LOD [μg.l^{-1}]
n-octane (C8)	0.008
n-nonane (C9)	0.008
n-decane (C10)	0.008
n-undecane (C11)	0.008
n-dodecane (C12)	0.008
n-tetradecane (C14)	0.008
n-pentadecane (C15)	0.008
n-hexadecane (C16)	0.008
n-heptadecane (C17)	0.008
n-octadecane (C18)	0.008
n-eicosane (C20)	0.008
n-tetracosane (C24)	0.008
n-octacos (C28)	0.008
n-dotriacontane (C32)	0.008
n-hexatriocontane (C36)	0.008
n-tetracontane (C40)	0.008

2. VOC (GC-FID)

Analyte	LOD [μg.l^{-1}]
1,2 dichlorethane	0,001
1,2 dichlorethylene	0,001
1,1 dichloretylene	0,001
Dichlormethane	0,001
Tetrachlorethane	0,001
Trichlormethane	0,001
Trichlorethylene	0,001
Tetrachlorethylene	0,001
1,1 dichlorethane	0,001
Chlorethane	0,001
Vinylchloride	0,001

3. BTEX (GC-FID)

Analyte	LOD [μg.l^{-1}]
Benzene	0,001
Chlorbenzene	0,001
Ethylbenzene	0,001
Styren	0,001
Xylen	0,001
Toluen	0,001
Izopropylbenzene	0,001
Cyklohexanone	0,001

4. OCP (GC-MS)

Analyte	LOD [μg.l^{-1}]
Alfa BHC	0,01
Beta BHC	0,01
Lindan	0,01
Delta BHC	0,01
Heptachlór	0,01
Aldrin	0,01
Heptachlorepoxide	0,01
Endosulphan I	0,01
Dieldrine	0,01
p,p´DDE	0,01
Endrine	0,01
Endosulphane II	0,01
p,p´ DDD	0,01
Endrinaldehyde	0,01
Endosulphansulphate	0,01
p,p´ DDT	0,01
Metoxychlor	0,01
Hexachlorbenzene	0,01
o,p DDD	0,01
o,p DDT	0,01
Isodrine	0,01

5. PCB (GC-ECD)

Analyte	LOD [μg.l^{-1}]
Delor 103	0,003
Delor 106	0,003
Kongener 28	0,003
Kongener 52	0,003
Kongener 101	0,003
Kongener 118	0,003

Kongener 138	0,003
Kongener 153	0,003
Kongener 180	0,003

6. PAH (HPLC-DAD/FLD,GC-MS)

Analyte	LOD [μg.l^{-1}]
Naphthalene	0.2
Benzo(*a*)pyrene	0.2
Dibenz(*a*,*h*)antracene	0.2
1-methylnaphthalene	0.2
2-methylnaphthalene	0.2
2-naphthylamine	0.2
Benzo(*b*)fluoranthene	0.2
Benzo(*k*)fluoranthene	0.2
Indeno(1,2,3-c,d)pyrene	0.2

7. Pesticides (GC-MS, LC-MS/MS)

8. Acid herbicides (GC-MS, LC-MS/MS)

Analyte	LOD [μg.l^{-1}]
Propazine	0,02
Prometryne	0,02
Simazine	0,02
Terbutryne	0,02
Terbutylazin	0,02
Desizopropylatrazine	0,05
Acetochlor	0,03
Desetylatrazine	0,02
Sebutylazin	0,02
Cyanazine	0,02
Isoproturon	0,02
Desmedipham	0,02
Chlorpropham	0,02
Penmedipham	0,02
Ethofumesate	0,02
Chlortoluron	0,02
Pendimetalin	0,02
Carboxin	0,02
Metamitron	0,05
Chloridazon	0,02
Clopyralid	0,02
Chlorfenvinfos	0,02

Analyte	LOD [μg.l^{-1}]

2,4-D	0,02
2,4-DB	0,02
MCPA	0,02
Dichlorprop	0,02
Bentazone	0,02
Dicamba	0,02
MCPB	0,02
MCPP	0,02
Triclopyr	0,02
2,4,5-T	0,02
Clopyralide	0,02

9. Aldehydes (GC-FID)

Analyte	**LOD [μg.l^{-1}]**
Formaldehyde	0.005
Acetaldehyde	0.005
Benzaldehyde	0.005
Butylaldehyde	0.005
Furfurale	0.005

10. Phthalates (GC-FID)

Analyte	**LOD [μg.l^{-1}]**
di-n-butylphthalat	2
bis(2-ethylhexyl)phthalat	5

11. Phenols (GC-FID)

Analyte	**LOD [μg.l^{-1}]**
phenol	0.001
2-methylphenole (o-crezol)	0.001
3-methylphenol (m-crezol)	0.001
4-methylphenol (p-crezol)	0.001
ethyleneglycol	0.001

12. Pharmaceuticals (LC-MS/MS)

Analyte	**LOD [μg.l^{-1}]**
Atenolol	0,07
Bezafibrate	0,09
Diclofenac	0,04
Carbamazepine	0,06
Cofeine	0,07

Primidone	0,06
Sulfadiazine	0,03
Sulfametoxazole	0,05

13. Hydroxy-s-triazines (HPLC- DAD, LC-MS/MS)

Analyte	LOD [µg.l^{-1}]
Hydroxyatrazine	0,06
Hydroxyterbuthylazine	0,06

IV.2.7.3. How do you calculate **accuracy and precision** (references)?

Accuracy was expressed by average yield for individual analytes of ten repeated measurements of two calibration points. Accuracy represents the average yield calculated from the individual measurements by comparing the average of the measured values with the reference value.
Precision of the calibration points for each analyte was expressed by the standard deviation under the repeatability conditions, respectively relative standard deviation of repeatability.

IV.2.8. XRD
IV.2.8.1. Please, state manufacturer and type of XRD instrument you use.
IV.2.8.2. Do you use **XRD for sediment analysis**?
IV.2.8.3. Please, describe **preparation of the sample and procedure** for XRD measurements

IV.3 Inventory of national laboratories where dangerous substances are analyzed, specifying whether they have accreditations on the quality of analyzes (certificate issued by the national body attesting the quality of the analyzes), price and time of analyses.

IV.4 Description of "good practices" in laboratory and “in situ” analysis. For example, ways to convert analytical data obtained from sediment analysis to water quality assessments (taking into account the high cost of water analysis compared to the sediment).

IV.5 Description of protocols for intercomparison and intercalibration between laboratories. List of national and internationals projects which had developed the Protocols.

[PLEASE, SUPPORT YOUR ANSWERS WITH REFERENCES (NATIONAL LEGISLATIVE DOCUMENTS AND/OR WEB LINKS)]

V .INVENTORY OF EVALUATION METHODS

V.1. 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.).
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 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.

V.2. Are **threshold values fixed or variable** and do they depend on the sample form, drainage basin lithology, time of the year, etc.?
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.

V.3. Do you use **corrections for threshold values**? (amount of **quartz**, **organic matter** etc.).
No correction for water. In case of results interpretation for sediments (but we dont have threshold values) we use corrections (granulometry, organic matter content).

V.4 The environmental quality objectives are based on measuring the total metal concentration and / or some dangerous compounds of that metal in different valence states?
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.

V.5 How the legislation reflects the phenomenon of “bioaccumulation”? Is the type of biota correlated with the ecosystem?
-

V.6. Does your national legislative find **categories of environment quality** based on deviations from threshold values?
-

V.7. Can these categories be **defined by quality of more than one medium?**
-

V.8. Please, describe **algorithm** for **defining** these **categories**? (e.g. weight coefficients).
-

V.9. How does your legislative framework define **difference** between **contamination** and **pollution**?
-

V.10. Do you **relate specific HSs** with **sources of contamination and pollution** and how?
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.

V.11. Please, describe **actions** in case of contamination and pollution.
-

V.12. How do you **present results** in your **reports**, e.g. do you use complex representation for scientific community or simple representation for target groups? Does the report include methodology, full results, QA/QC, models? Are these results public or can be obtained by request?
Data (groundwater ad surface water) is published in annual reports released by Slovak hydrometeorological institute which contained the result interpretaion (data comparison with standards). The reports are available to the public: www.shmu.sk.

V.13. Do you have a method for **space-time risk assessment** after determination of contamination and/or pollution?
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)

Monitoring of stream sediments (SGIDS)

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 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 geostatistic treatment of the results in the map of the distribution of the contamination index).

Statistical evaluation of the taken samples

Characteristics of chemical composition of stream sediments are processed by standard **statistical methods**, mainly using descriptive statistical parameters (mean, median, standard deviation, minimum, maximum). The variability of the indicator values in the statistical file is expressed through variability. Temporal variability basically expresses the stability of the element content in sediment at individual sites during the 23-year monitoring period. It is evaluated by the coefficient of variation, the calculation of which is based on the percentage ratio of the standard deviation to the arithmetic mean value for each observed parameter and each monitored site:

$\nu_{č} = \frac{s_{ij}}{\bar{x}_{ij}}.100 \quad [\%]$, where:

s_{ij} standard deviation of i-component on j-site

$\bar{x}_{ij}$ the arithmetic mean of the i-component on the j-site.

The average value of the temporal variability and i-component for all sites of ν average is calculated from the relation: $\bar{\nu}_{č} = \frac{1}{n}\sum_{j=1}^{n}\nu_{č}$, where *n* is the number of monitored sites.

Similarly, the spatial variability of the element is solved by the coefficient of spatial variation. It is characterized by the relation expressing the standard deviation to the arithmetic mean value of all measurements of the observed element (compound):

$\nu_{p} = \frac{s}{\bar{x}}.100 \quad [\%]$.

In order to assess the content of contaminants in stream sediments, a **legislative approach** comparing the measured content of elements with specific limit concentrations is used in the monitoring. In accordance with the recommendation of the MoE SR Directive no. 4 / 1999-3 for the compilation and publication of the geochemical map of river sediments at a scale of 1:50 000, limit concentrations valid for soils are used for the purpose of assessing the contamination of stream sediments within the framework of monitoring (MP SR Decision No. 531/1994 on the highest permissible values of harmful substances in the soil). In the context of the objectives of the river sediment monitoring system, the "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" is applied, based on internationally applicable standards, regulations and procedures applied primarily in EU and North American countries.

The principle of evaluation according to the Methodological Instruction no. 549 / 98-2 is based on the recalculation of the measured values into the so-called standardized sediment and its comparison with limit values. The standardized sediment is a sediment containing 25% of the pelite fraction (i.e., silt / clay fraction with a particle size of less than 0.063 mm) and 10% organic matter after conversion. The pelit fraction of sediments is used because it preferentially bind contaminants to this granular fraction of sediments. For metals, the conversion of the natural composition of a natural sediment into a standardized sediment is done through the relationship:

$$C_{sed(št)} = C_{sed} \cdot \frac{A + 25B + 10C}{A + B.L_{sed} + C.OH_{sed}}$$, where

$C_{sed(st)}$ - concentration of the relevant element in the analyzed sediment, recalculated on the sediment of the standardized composition (mg.kg-1),

C_{sed} - concentration of the relevant element in the analyzed sediment (mg.kg-1),

L - pelite fraction (fraction <0.063 mm) in the analyzed sediment (%)

OH_{sed} - content of organic matter in analyzed sediment (%).

A, B, C - constants determined for the relevant metal.

For specific organic substances, the conversion of the chemical composition of natural sediment into standardized sediment is carried out by means of the relationship:

$$C_{sed(št)} = 10. \frac{C_{sed}}{OH_{sed}}$$, where

$C_{sed(st)}$ - concentration of the relevant organic substance in the analyzed sediment, calculated on the standardized sediment sediment (mg.kg-1)

C_{sed} - concentration of relevant organic substance in analyzed sediment (mg.kg-1)

OH_{sed} - content of organic matter in analyzed sediment (%).

When converting to the sediment of the standardized composition, the value of the organic matter content (and not the organic carbon) must always be substituted. The above formula is normalized to organic matter content in sediment at 2-30%. If the organic matter content is below 2% in the sediment, then the value of organic matter is fixed to 2.

The results of the overall sediment evaluation are classified into three basic classes based on the assessment of the effect of sediment on the ecosystem:

- no effect - the measured values for each chemical or compound are less than the MPC (maximum allowable concentration) limit set out for sediment dry matter
- potential risk - measured values for at least one chemical or compound are ≥ MPC, respectively < as IV (intervention value)
- serious risk - measured values for at least one chemical or compound are ≥ IV.

Limit values of concentrations of harmful substances used for assessment of sediment quality - part I.2.

Parameter	MP MŽP č. 549/98-2 (mg.kg^{-1})				Rozhodnutie MP č. 531/94-540 (mg.kg^{-1})		
	TV	MPC	TVd	IV	A	B	C

Explanation:

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)

The nature of pollutants, resp. exceeds the specified limits, is characterized by the contamination index C_d. The approach is based on a **legislative assessment of pollution parameters and subsequent geo-statistical processing of results** in a dedicated contamination index distribution map. The contamination index values are calculated from the sum of the absolute concentration ratios of the parameters under consideration to their limit contents (Slaninka, 1994; Backman et al., 1998):

$$C_d = \sum_{i=1}^{n} \left(\frac{C_{Ai}}{C_{Ni}} - 1\right)$$

where: C_{Ai} i-component analytical value

C_{Ni} limit (normative) value of i-component.