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IRON GATES SEDIMENT EVALUATION - SERBIA

Final Report

WORKING FOR THE DANUBE AND ITS PEOPLE

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1 INTRODUCTION

Sediment is identified as the largest contaminant of surface waters. Therefore, the understanding of sediment-bound pollutants requires an understanding of sediment transport and deposition. On the other hand, the pollution of sediment already deposited in a reservoir can be an indicator of the water quality during the reservoir's lifetime.

The objectives of this project were to determine the sediment quality in the Iron Gate Reservoir, document the occurrence of specified pollutants, and prepare initial recommendations for future protection of the Danube River and the Black Sea. It is difficult to estimate long-term trends of the selected chemical constituents.

The project involved an assessment of data and information on the Iron Gate sediments and is a step forward in identifying existing information gaps. The project included field activities, laboratory analyses, and the preparation of a study report.

To achieve the objectives of the project, national teams from Serbia and Romania collected and reviewed available data and information on sediment quality in the Iron Gates reservoir area. The next step in identifying potential environmental impacts on the Danube and the Black Sea was a sediment survey, which was carried out in September of 2006 by the ship ARGUS. Sediment samples were taken from both the left and right banks of the river and analyzed for an agreed list of determinands at national laboratories and at the VITUKI.

2 2006 SEDIMENT SURVEY RESULTS AND DATA ASSESSMENT

As part of the project, a sampling survey was carried out on September 11 to 13, 2006 by the ship ARGUS. Grab and core samples were taken at 10 pre-selected sections in the Iron Gate reservoir area, along the Danube reach from river km 928 (Mala Vrbica/Simian) to 1107 (upstream from the Velika Morava). The sampling sites and sampling dates are identified in Table 1.

Sediment samples were analyzed in order to assess pollutant accumulation in the sediment. The parameters included: total heavy metals (Zn, Cu, Cr-tot., Ni, Cd, As, Hg and Pb), nitrogen content (total N), phosphorus content (total P), extractable petroleum hydrocarbons, organochlorine pesticides (DDT, lindane, aldrin, endrin, dieldrin), nonylphenol, octylphenol, pentachlorphenol, di(2-ethylhexyl)phthalate, PAHs, and PCBs.

Surface sediment was sampled by a standard Ponar dredge. Grab sediment samples were taken from both the left and right banks of the river, at each sampling site, except at Site 8 (Dubova, river km 971) where no sediment was found on the left side. This was followed by on-board wet sieving in order to obtain less-than 63 µm fractions for later chemical analysis in the lab.

Core sampling was carried out using an Eijkelkamp core sampler and samples were taken from the right side at river km 1077 (Stara Palanka – Ram) and at km 924 (Vrbica/Simian), as well as from both sides of the river at sampling sites 7 and 9 (Donji Milanovac, river km 991; and Orsova, river km 956, respectively). The core sample was then divided into 10-centimeter slices for further analysis in the lab.

Measurements and laboratory tests were performed at the Public Health Institute of Belgrade, applying prescribed and standard methods. The results of sediment sample particle-size distribution analysis are presented in Annex 1. Measurement results are presented in Annex 2.

Table 1: September 2006 sediment survey sampling sites and sampling dates

Iron Gates sample number	Sample type	Km index	Location	Location in Profile	GPS Coordinates						Sampling Date [YYYY/MM/DD]	S. Time [HH:MM]
					Latitude			Longitude				
					°	`	``	°	`	``		
1	Grab	1107	Upstream from the Velika Morava	L	44	43	33.8	21	00	09.9	2006.09.11	13:30
1	Grab	1107	Upstream from the Velika Morava	R	44	42	58.1	21	00	25.8	2006.09.11	12:50
2	Grab	1097	Downstream from the Velika Morava	L	44	44	16.4	21	07	37.0	2006.09.11	14:45
2	Grab	1097	Downstream from the Velika Morava	R	44	43	44.8	21	07	51.8	2006.09.11	14:57
-	**Core**	**1077**	**Stara Palanka - Ram**	**R**	**44**	**48**	**33.0**	**21**	**19**	**43.2**	**2006.09.11**	**17:00**
	0-10 cm											
-	10-20 cm											
-	20-30 cm											
-	30-40 cm											
-	40-50 cm											
-	50-60 cm											
-	60-70 cm											
-	70-77 cm											
3	Grab	1072	Bazias	L	44	48	12.9	21	23	31.0	2006.09.11	19:10
3	Grab	1072	Bazias	R	44	48	17.3	21	22	48.4	2006.09.11	19:30
4	Grab	1061	Veliko Gradiste / Belobresca	L	44	46	33.2	21	29	44.6	2006.09.12	10:00
4	Grab	1061	Veliko Gradiste / Belobresca	R	44	46	05.3	21	29	36.3	2006.09.12	10:20
5	Grab	1040	Golubac / Koronin	L	44	40	06.7	21	41	20.0	2006.09.12	12:15
5	Grab	1040	Golubac / Koronin	R	44	39	40.8	21	41	2.6	2006.09.12	12:00
6	Grab	1022	Dobra Lubcova	L	44	38	59.9	21	53	51.3	2006.09.12	14:10
6	Grab	1022	Dobra Lubcova	R	44	38	38.7	21	52	56.4	2006.09.12	14:00
7	Grab	991	Donji Milanovac	L	44	28	45.4	22	08	35.8	2006.09.13	10:30
7	Grab	991	Donji Milanovac	R	44	27	56.3	22	08	15.1	2006.09.13	9:30

Iron Gates sample number	**Sample type**	**Km index**	**Location**	**Location in Profile**	**GPS Coordinates**						**Sampling Date [YYYY/MM/DD]**	**S. Time [HH:MM]**
					Latitude			Longitude				
					°	`	``	°	`	``		
-	**Core**	**991**	**Donji Milanovac**	**L**	**44**	**28**	**45.4**	**22**	**08**	**35.8**	**2006.09.13**	**12:00**
	0-10 cm											
-	10-20 cm											
-	20-30 cm											
-	30-40 cm											
-	40-50 cm											
-	50-60 cm											
-	60-70 cm											
-	70-74 cm											
-	**Core**	**991**	**Donji Milanovac**	**R**	**44**	**27**	**56.3**	**22**	**08**	**15,1**	**2006.09.13**	**9:45**
	0-10 cm											
-	10-20 cm											
-	20-30 cm											
-	30-40 cm											
-	40-50 cm											
-	50-60 cm											
-	60-67 cm											
No sediment found on the left side												
8	Grab	971	Dubova	R	44	36	23.0	22	16	24,6	2006.09.13	11:40
9	Grab	956	Tekija / Orsova	L	44	41	26.0	22	23	43,9	2006.09.13	13:50
9	Grab	956	Tekija / Orsova	R	44	41	03.4	22	24	26,1	2006.09.13	13:20
-	**Core**	**956**	**Tekija / Orsova**	**L**	**44**	**41**	**26.0**	**22**	**23**	**43,9**	**2006.09.13**	14:00
	0-10 cm											
	10-20 cm											
	20-30 cm											
	30-40 cm											
	40-50 cm											
	50-60 cm											
	60-70 cm											

Iron Gates sample number	Sample type	Km index	Location	Location in Profile	GPS Coordinates						Sampling Date [YYYY/MM/DD]	S. Time [HH:MM]
					Latitude			Longitude				
					°	`	``	°	`	``		
	70-78 cm											
	Core	**956**	**Tekija / Orsova**	**R**	**44**	**41**	**03.8**	**22**	**24**	**26.7**	**2006.09.13**	13:30
	0-10 cm											
	10-20 cm											
	20-30 cm											
	30-40 cm											
	40-50 cm											
	50-60 cm											
	60-70 cm											
	70-82 cm											
10	Grab	928	Mala Vrbica / Simian	L	44	37	12.1	22	41	06.9	2006.09.13	19:30
10	Grab	928	Mala Vrbica / Simian	R	44	36	29.8	22	40	47.6	2006.09.13	19:00
	Core	**928**	**Mala Vrbica / Simian**	**R**	**44**	**36**	**29.8**	**22**	**40**	**47.6**	**2006.09.13**	19:00
	0-10 cm											
	10-20 cm											
	20-30 cm											
	30-40 cm											
	40-50 cm											
	50-60 cm											
	60-70 cm											
	70-80 cm											

2.1 HEAVY METALS

Analysis of heavy metals (As, Cu, Zn, Cr-tot., Cd, Ni, Pb and Hg) in sediments of the Danube River was carried out using a wet sieved, below 63μm fraction to minimize the "dilution" effect of larger particles with low element concentrations.

Figure 1 shows the number of sediment samples (%) for which determined element concentrations exceed quality targets. The concentrations of copper, zinc and nickel were above quality targets for more than one half of all samples. The sediments of the Danube River can be regarded as unpolluted in terms of arsenic, chromium, mercury, and lead.

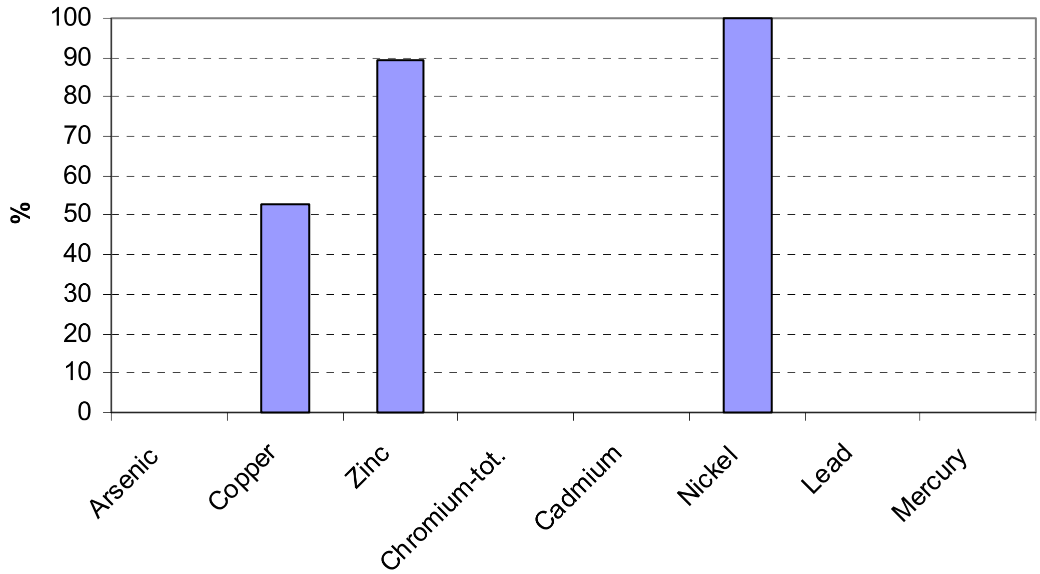


Figure 1. Number of sediment samples (%) whose heavy metal concentrations exceed the quality targets listed in Table 2.

Concentrations of cadmium and mercury were below the detection limit of the method. Since the determined concentrations of mercury (<0.4 mg/kg) are below the quality target of 0.8 mg/kg, sediment samples can be regarded as unpolluted. However, the detection limit for cadmium (2.0 mg/kg) is higher than the quality target (1.2 mg/kg) and, as a result, a reliable picture of sediment pollution cannot be obtained.

Table 2. Ranges of element concentrations in bottom sediment samples of the Danube River, and comparison with quality targets

Heavy metals	**Concentration (mg/kg)**			**QT (mg/kg)**
	Min.	**Max.**	**Average**	
As	5.8	17.1	9.9	20
Cu	40.9	310.7	77.9	60
Zn	101.1	340.7	246.2	200
Cr-tot.	25.1	68.3	46.9	100
Cd	<2.0	<2.0	-	1.2
Ni	33.4	105.2	60.0	50
Pb	23.2	77.6	51.9	100
Hg	<0.4	<0.4	-	0.8

"<" below the quantitation limit of the method.

The investigation of the upper sediment layer quality revealed that the sediment can be regarded as unpolluted in terms of arsenic, chromium and lead. The concentrations of copper, nickel and zinc were above quality targets. The spatial distribution of analyzed metals in sediments from the studied area is shown in Figure 2.

A graphical representation of zinc and copper concentrations along the investigated section of the Danube reveals a slight increasing trend downstream. Relatively comparable copper concentrations were found on both the left and right banks of the river, except for copper content at the Golubac profile (river km 1040). Figure 2 clearly shows a sudden increase in the copper concentration in the surface layer of the sediment on the left bank of the river. It rose to about 310 mg/kg, and then dropped back to 65 mg/kg.

The distribution of other elements along the investigated sector is heterogeneous. In general, heavy metal concentrations in sediment samples from the right bank of the river are slightly higher than in those from the left bank. In the case of arsenic, lead, chromium and nickel, higher values were found along the upper stretch of the Danube, upstream from the Golubac profile. There is no significant downstream tendency of measured parameters.

Based on element concentrations in sediment samples taken from the left bank of the river, there is no apparent downstream tendency. Relatively constant concentrations of chromium and nickel up to river km 1061 were followed by a slight decrease up to river km 1040 (Golubac). An increasing trend was noted downstream from the Golubac profile. A similar pattern was observed for zinc and lead.

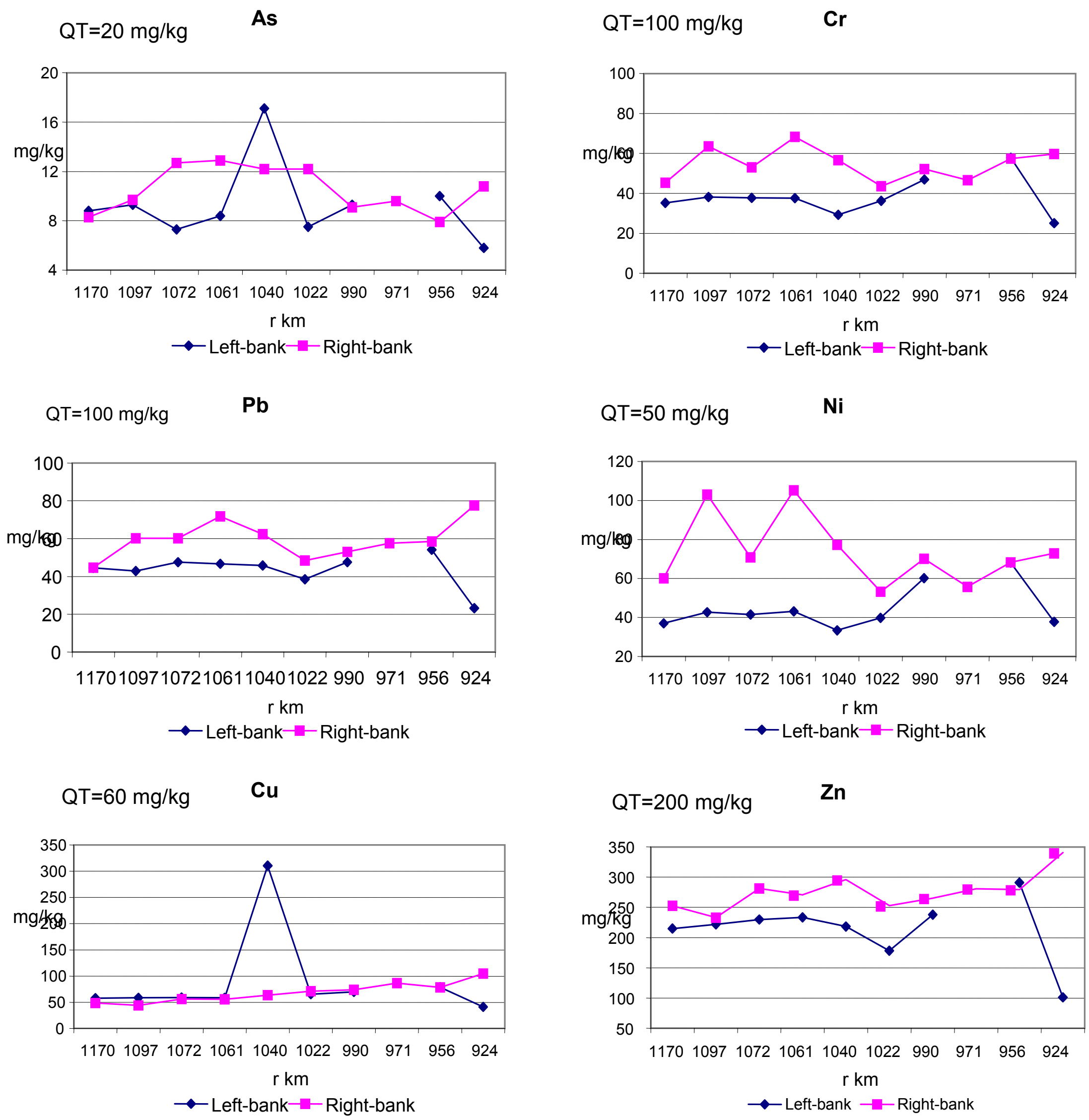


Figure 2. Longitudinal variation in bottom-sediment heavy metal concentrations

Lead concentrations in sediment core samples collected from the studied area are in the interval from 28 to 74 mg/kg, with the exception for two measurements, which were close to the quality target of 100 mg/kg. Maximum values were measured at river km 991 (the Donji Milanovac profile). No significant changes in lead content were found in sediment core samples taken at the Tekija and Mala Vrbica profiles. However, at the Donji Milanovac profile, a significant increase was detected from the sediment surface down to 50 cm. Thereafter, lead concentrations start decreasing to the bottom.

The vertical distribution of heavy metals in sediment core samples is shown in Figure 3.

Total zinc content in sediment core samples varied from 150 to 463 mg/kg. In general, the highest concentrations were found in the layer from -40cm to 70cm. The maximum zinc content was registered at the Tekija profile, at a depth of 70cm. A graphical representation of zinc concentrations shows a decreasing trend from deeper layers to the surface. The distribution of zinc concentrations shows that most of the data are above the quality target.

A similar pattern was observed for copper. Measured values were higher than the quality target of 60 mg/kg. The maximum copper content was registered at the Donji Milanovac profile (159 mg/kg), at a depth of 60cm.

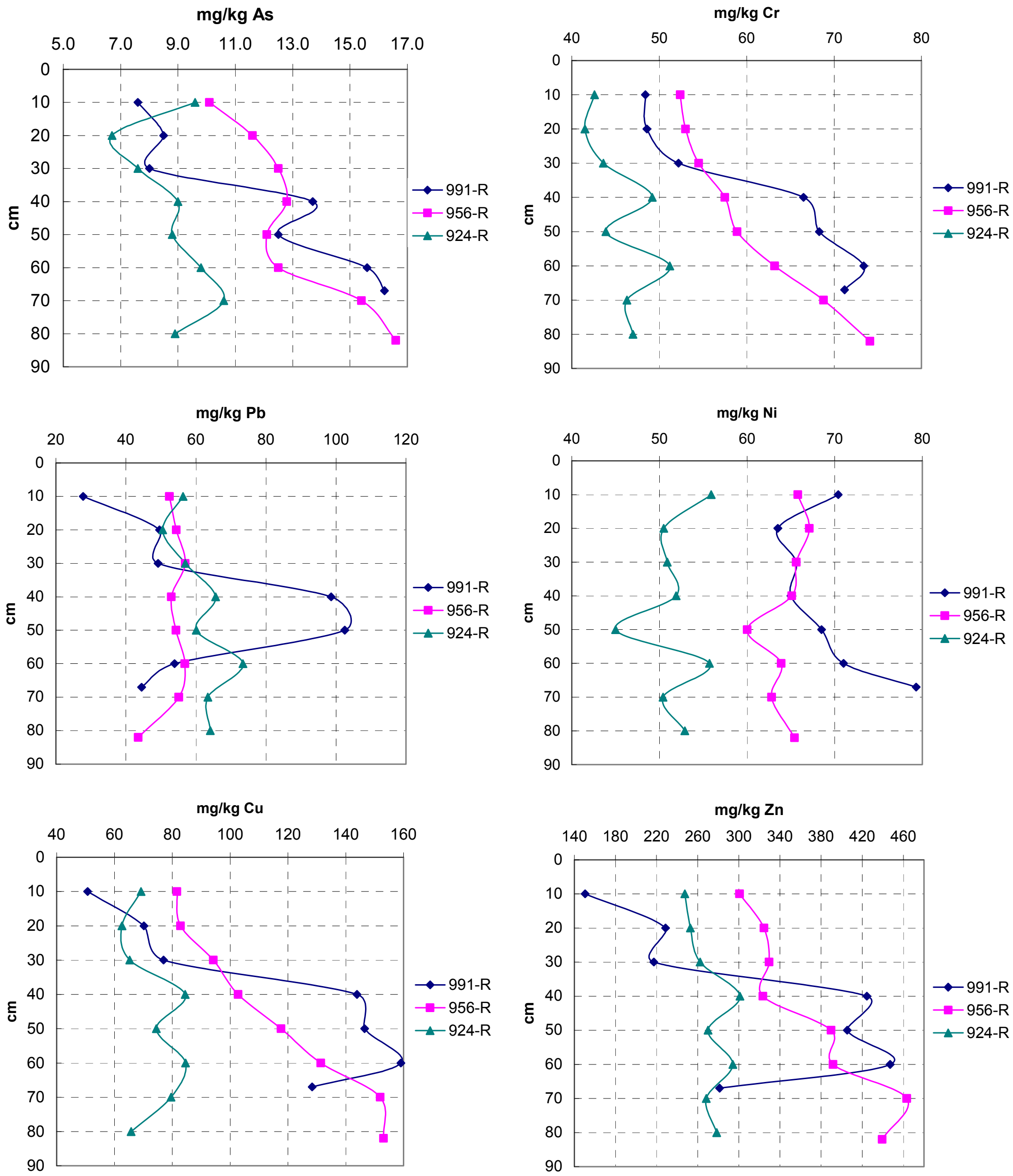


Figure 3. Vertical variation in heavy metal concentration in sediment core samples

Chromium concentrations were below the quality target of 100 mg/kg, indicating that the sediment is not polluted with this metal. Measured values range from 41.5 to 74.1 mg/kg. Figure 3 shows a decreasing chromium content from deeper layers to the surface. The highest chromium concentrations were found in sediment cores collected at the Donji Milanovac and Tekija profiles.

No arsenic concentration exceeds the quality target of 20 mg/kg and, therefore, the sediment can be regarded as unpolluted in terms of arsenic. The variation interval of arsenic concentrations is 6.7-16.6 mg/kg. As shown in Figure 3, arsenic content exhibits a decreasing trend from deeper layers to the surface.

No significant changes in nickel distribution can be observed. The total nickel content ranges from 45.0 to 79.3 mg/kg. Measured values were higher than the quality target with the exception for one measurement, which was just below the quality target of 50 mg/kg. Maximum concentrations were measured in the sediment sampled from the Donji Milanovac profile.

In general, lowest element concentrations were observed in the sediment core sampled from the Mala Vrbica profile.

2.2 NUTRIENTS

Total nitrogen and total phosphorus concentrations were measured in sediment samples. Figures 4 and 5 show longitudinal variations in total P and total N in the bottom sediment. The values of total P in the surface sediment layer ranged from 638 to 1165 mg/kg, with an average concentration of 900 mg/kg. As shown in Figure 4, lower values were registered at the Golubac and Mala Vrbica profiles (left bank). Maximum values were detected at the Mala Vrbica profile (right bank), downstream of the Iron Gate I HPNS.

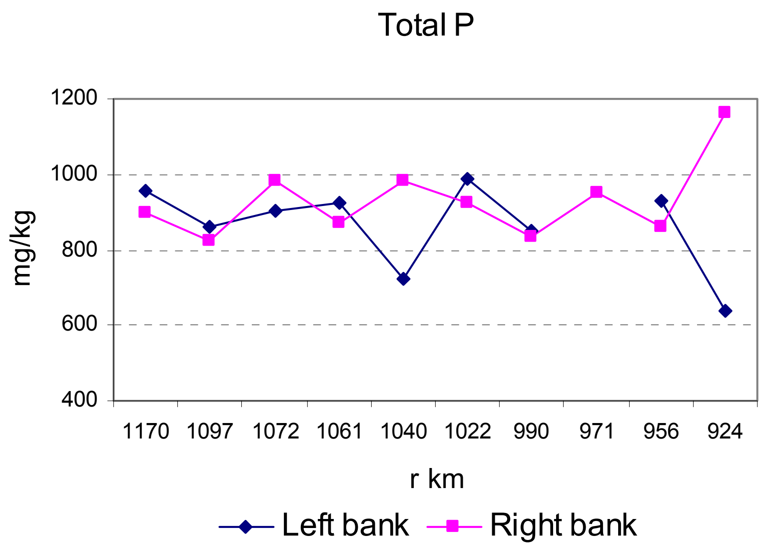


Figure 4. Longitudinal variation in bottom-sediment total P concentration

Total nitrogen content varied from 1600 to 3400 mg/kg, with an average concentration of 2400 mg/kg, as shown in Figure 5. The concentration increased downstream, from river km 1170 to 1022 of the Serbian section of the Danube. There was a sudden decrease in nitrogen content at the Donji Milanovac profile. It dropped to about 1700 mg/kg, and then increased again to 3400 mg/kg. As shown in Figure 5, the distribution of total nitrogen along the investigated Romanian sector is heterogeneous.

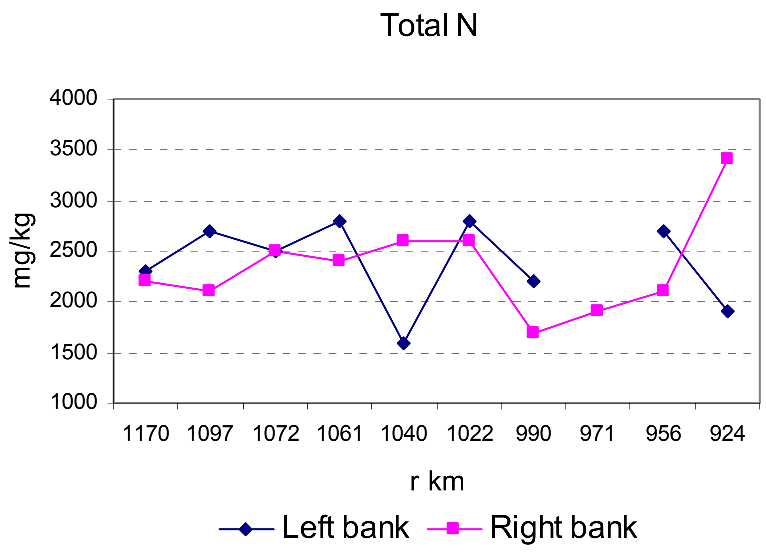


Figure 5. Longitudinal variation in bottom-sediment total N concentration

Total phosphorus and total nitrogen distributions in the sediment core samples are shown in Figures 6 and 7. The overall phosphorus contamination of sediment cores was in the similar range as that of surface sediment samples. Total P concentrations range from 628 to 1580 mg/kg, with an average concentration of 1048 mg/kg. The highest values were recorded in deeper sediment layers. Maximum values were detected at the Mala Vrbica profile, downstream of the Iron Gate I HPNS.

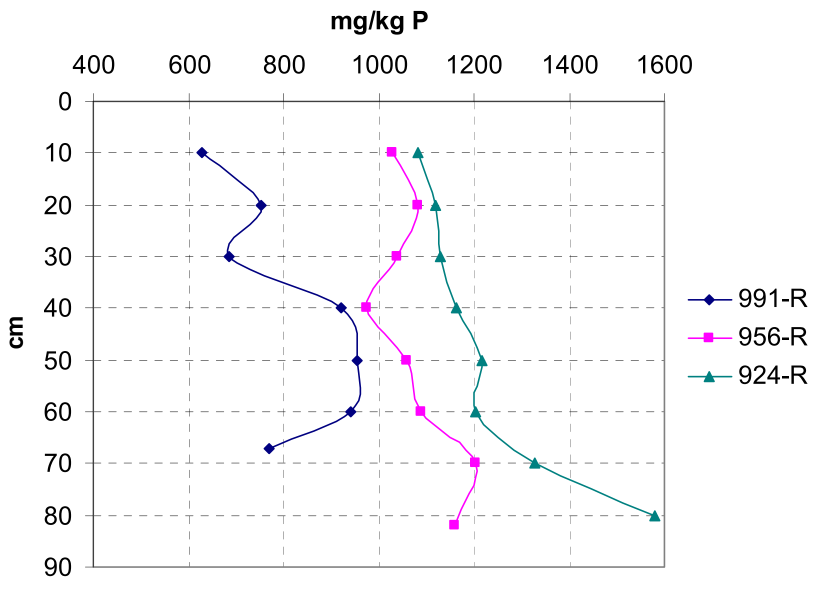


Figure 6. Vertical variations in bottom-sediment total phosphorus concentration

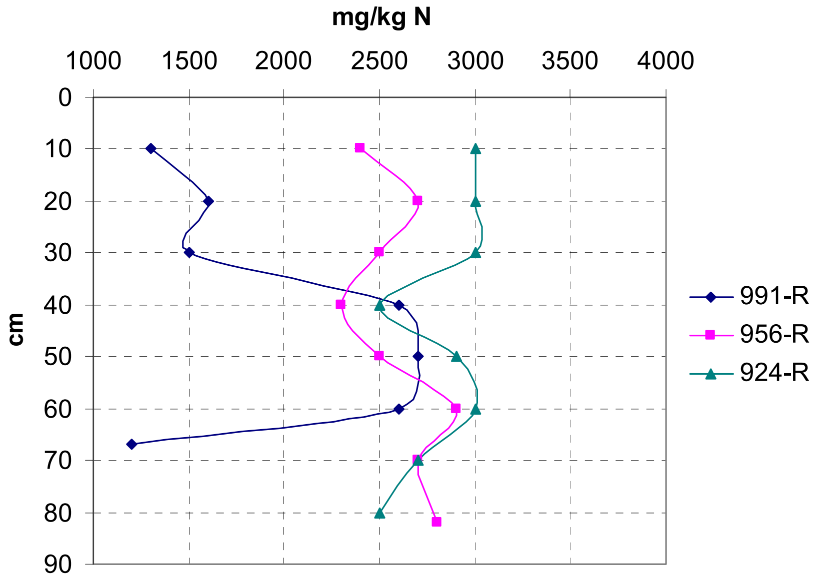


Figure 7. Vertical variations in bottom-sediment total nitrogen concentration

As shown in Figure 7, no characteristic concentration distribution was found in sediment core samples, with the exception of the *Donji Milanovac* profile. The total nitrogen content varied between 1300 and 2700 mg/kg. Maximum concentrations were registered in the 40-60 cm layer.

2.3 ORGANIC POLLUTANTS

2.3.1 Polyaromatic Hydrocarbons (PAHs)

The sum of the 16 analyzed PAH congeners varied between 56.4 and 477.5 µg/kg in bottom sediment samples. The results of PAH determinations for bottom sediment samples are shown in Figure 8.

Fluoranthene, Pyrene and Phenantrene dominated PAH contamination of most of the sediment samples. The PAH distribution in sediment core samples is shown in Figures 9 through 11. The highest values were recorded in the deeper sediment layers.

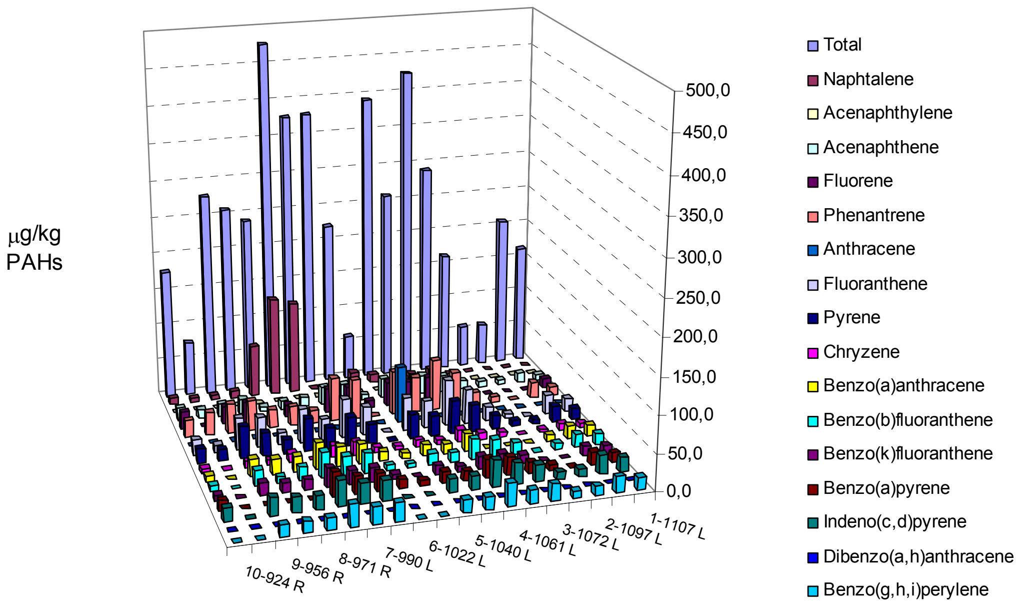


Figure 8. Longitudinal variation in individual PAH concentrations in bottom sediment samples

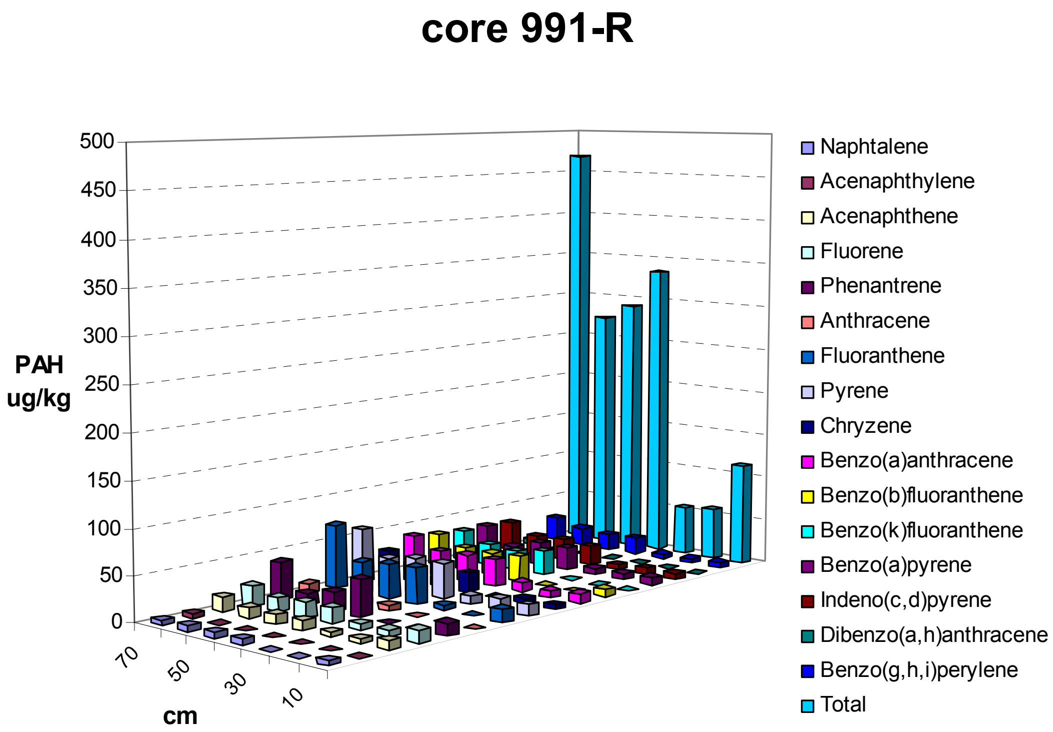


Figure 9. Vertical variation in individual PAH concentrations in sediment core samples

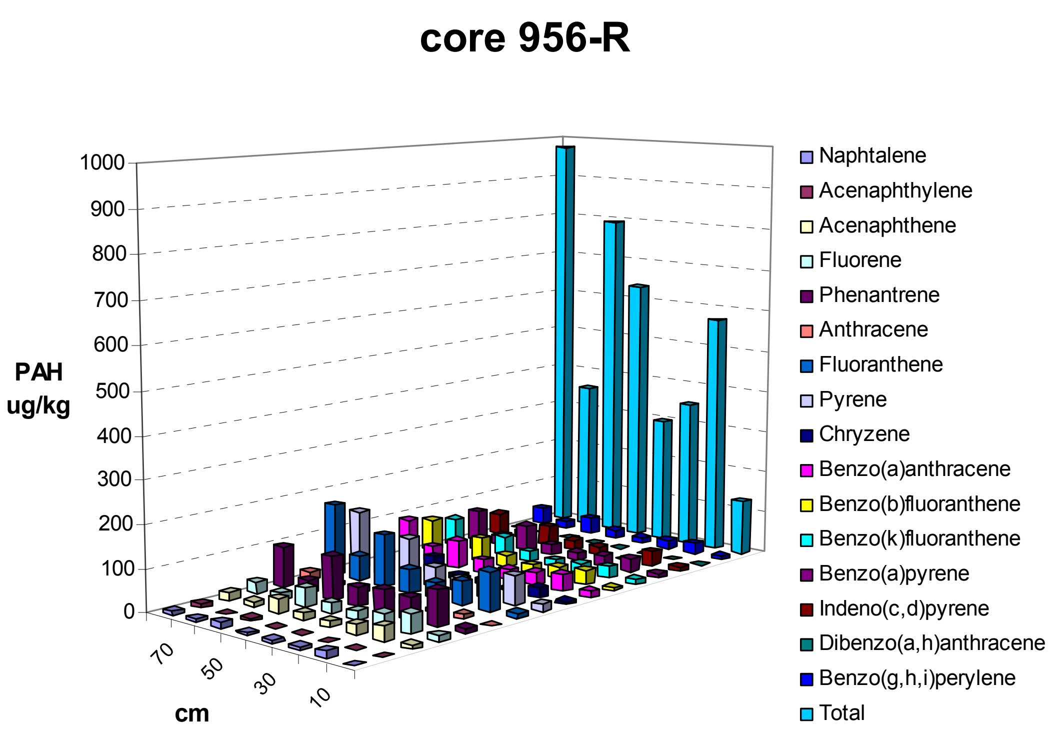


Figure 10. Vertical variation in individual PAH concentrations in sediment core samples

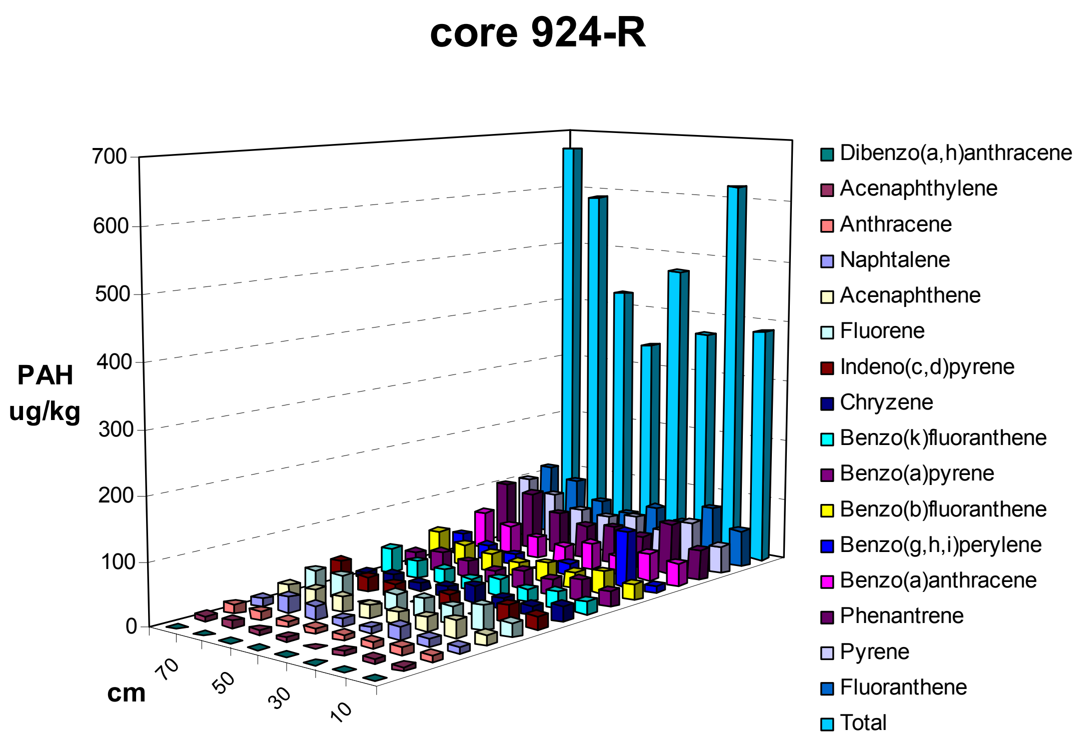


Figure 11. Vertical variation in individual PAH concentrations in sediment core samples

2.3.2 Pesticides

Sediment samples (both bottom and core) were analyzed for the occurrence of the following pesticides: DDT, Lindane, Aldrin, Endrin and Dieldrin. All pesticides were found in concentrations below the limit of determination (10µg/kg).

2.3.3 Petroleum Hydrocarbons

Earlier surveys and monitoring had revealed a significant level of oil pollution in the Danube River Basin. Therefore, special attention was devoted to the determination of oil pollutants.

Total petroleum hydrocarbon (TPH) pollution was analyzed in bottom sediment samples. TPH content varied from <5 to 398 mg/kg, with an average concentration of 51.2 mg/kg. Relatively comparable concentrations were found on both the left and right banks of the river, except for TPH content at river km 1022. Figure 12 clearly shows a sudden increase in the TPH concentration in the surface layer of the sediment at the Dobra profile.

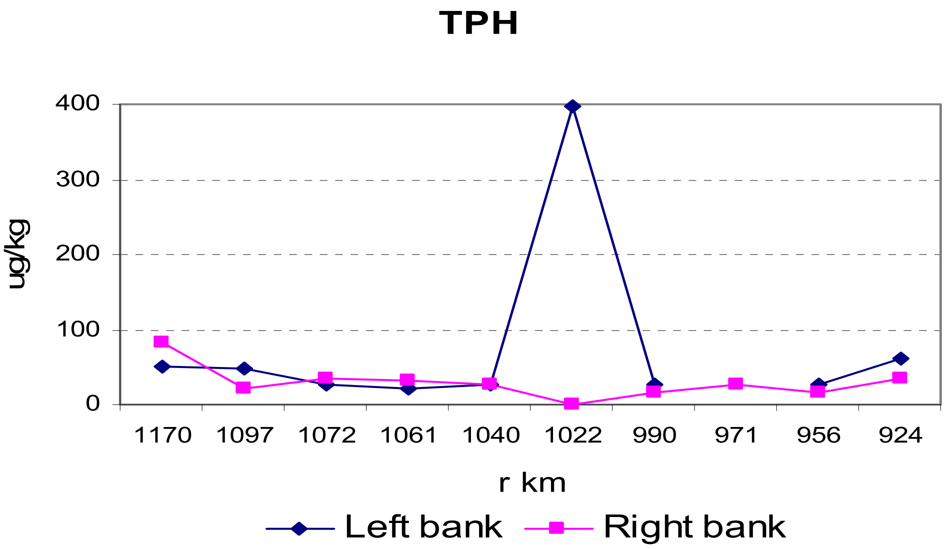


Figure 12. Longitudinal variation in bottom-sediment TPH concentration

The vertical TPH distribution in sediment core samples is shown in Figure 13. The vertical variation was influenced by sedimentation and hydrological conditions.

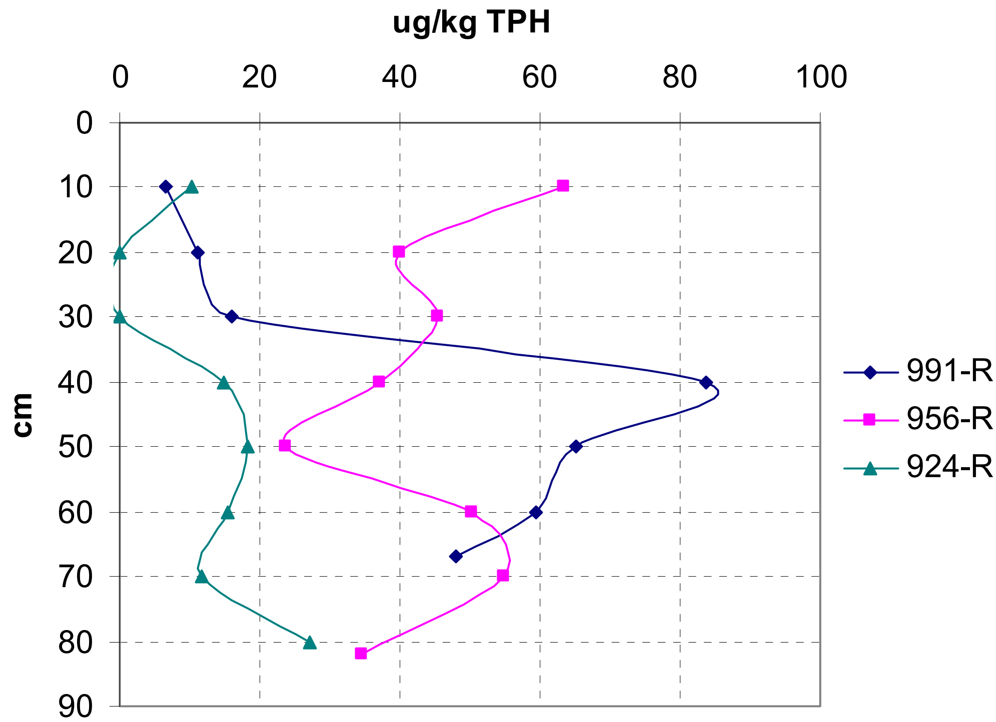


Figure 13. Vertical variation in TPH concentration in sediment core samples

2.3.4 Polychlorinated biphenyls

Sediment samples (both bottom and core) were analyzed for the occurrence of the following polychlorinated biphenyls: PCB 28, PCB 52, PCB 101, PCB 118, PCB 138, PCB 152 and PCB 180. All polychlorinated biphenyls were found in concentrations below the limit of determination (10µg/kg).

2.3.5 Other WFD Priority Pollutants

The data presented in the tables shows that pentachlorophenol was found neither in the surface sediment nor in the sediment core samples under investigation. Nonylphenol and octylphenol were detected in all samples.

Di(ethylhexyl)phthalate (DEHP) was found in 63% of all grab samples, with a median concentration of 139 µg/kg. Most of the higher concentrations were found in the Serbian section of the Danube. DEHP concentrations were mainly between 0.1 mg/kg and 0.5 mg/kg. The hot spot was the 7-990 (Donji Milanovac) profile.

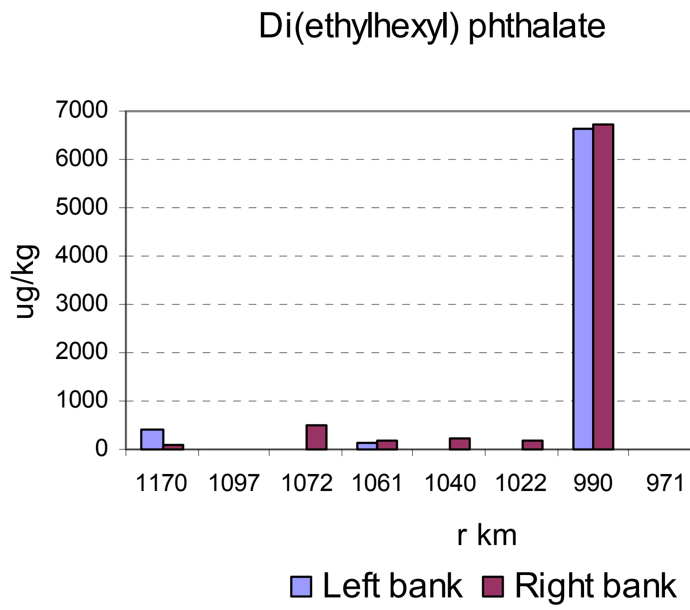


Figure 14. Longitudinal variation in bottom-sediment DEHP concentration

The two analyzed grab samples collected at the Donji Milanovac profile (7-990 L and 7-990R) showed a high contamination level; however, the DEHP contamination level in the sediment core from the same profile was significantly lower (see Figure 15).

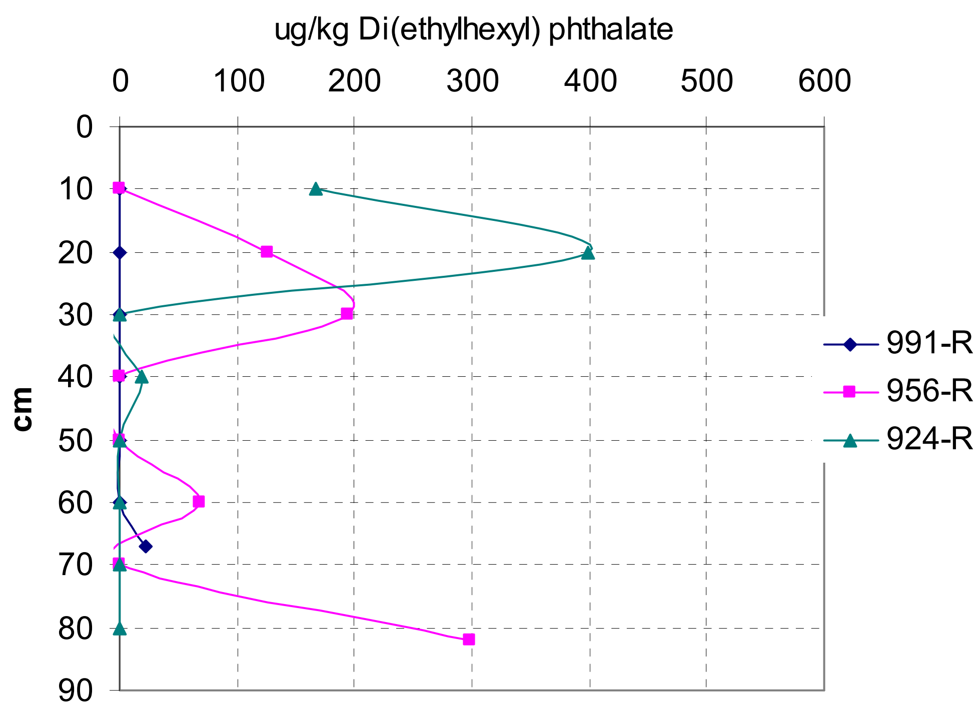


Figure 15. Vertical variation in DEHP concentration in sediment core samples

3 CONCLUSIONS OF THE SEPTEMBER 2006 SEDIMENT SURVEY

- The sediment sampling survey was carried out in September of 2006 by the ship ARGUS. Samples for sediment quality investigations were taken from 10 sections along the Danube, between river km 928 and 1107. The sediment sampling survey was performed according to the proposed plan: grab samples and core samples were taken at preselected sites within the Iron Gate reservoir area. Measurements and laboratory tests were performed in accordance with prescribed and standard methods.

- Analytical results indicate the spatial (longitudinal, cross-sectional and vertical profiles) concentration distribution of different contaminants in the bottom sediment of the Iron Gate Reservoir.

- Based on the results of the analysis of heavy metals in surface sediment samples from the studied area, no significant downstream tendency of measured parameters was observed. In general, heavy metal concentrations in sediment samples collected from the right bank of the river are slightly higher than in those collected from the left bank.

- Vertical profiles of core samples indicate sediment pollution across the entire profile, from deeper layers to the sediment surface.

- Sediments of the Danube River can be regarded as unpolluted in terms of arsenic, chromium, mercury and lead. Concentrations of copper, zinc and nickel were above quality targets for more than one half of all samples.

- All pesticides and analyzed polychlorinated biphenyls were found in concentrations below the limit of determination (10µg/kg).

4 RECOMMENDATIONS FOR FURTHER MONITORING PROGRAMMES

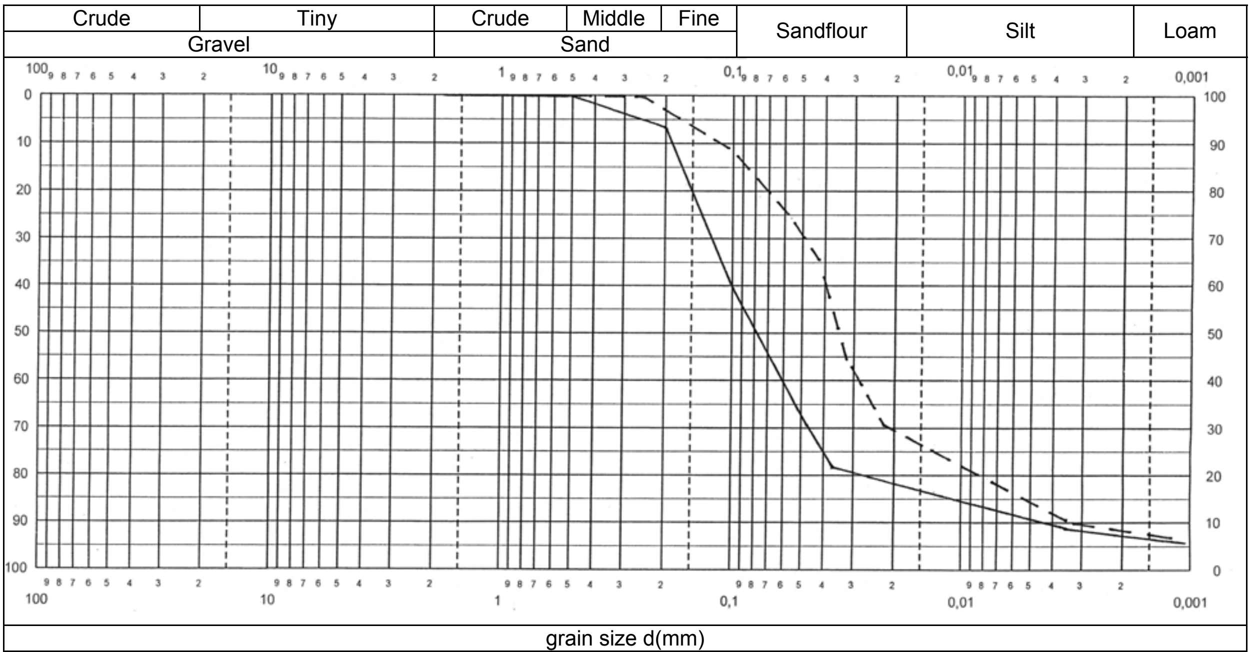
The current sediment quality monitoring practice focuses on assessing the compliance of determined concentrations of selected contaminants with pre-defined quality standards (if available).

It is recommended to continue sediment quality monitoring within the scope of the TNMN, and to continue periodical sediment investigations in Joint Danube Surveys. It is necessary to identify and summarize the pollution which reaches the water via transboundary rivers: the Danube, Drava, Tisa, Sava, Tamis and Begej; and rivers within Serbia: the Velika Morava and Timok; as well as the contribution of point and non-point pollution sources within the territory of the Republic of Serbia which discharge their wastewater into the Danube River.

Further monitoring programmes for the Iron Gate reservoir area should include the following:

- Monitoring of WFD priority hazardous substances that have a strong preference to accumulate in sediment;
- Given the WFD objective of "non-deterioration" of sediment quality, monitoring of the above mentioned substances should be applied both in terms of spatial and trend monitoring. Spatial monitoring is necessary in order to evaluate the extent to which a certain contaminant is spread over a studied area and, possibly, to detect its source based on available emission data. Trend monitoring should be carried out in order to evaluate the temporal pattern over a long period of time. This type of programme should also include the study of deeper sediment layers in order to identify the contamination history;
- Along the Iron Gate area, spatial monitoring (surveys) should include at least the sampling sites from the studies that have been taken into account in this evaluation (2001 and 2004 data) and those that have been included in the September 2006 sampling campaign;
- The current monitoring programme (hazard assessment method as the first element of the Triad-approach) could be complementary, followed by the evaluation of the toxic effect of sediment on organisms using bioassays, and by impact assessment using field inventory (assessment of the taxonomic composition and abundance of benthic invertebrate fauna).
- The frequency of Iron Gate sediment monitoring should be established based on a common agreement among the stakeholders involved, and based on technical criteria such as: the current information on sediment quality compliance with EQSs, the sedimentation rate, and the existing or further identification of new anthropogenic pressures.

5 ANNEX 1: RESULTS OF SEDIMENT SAMPLE PARTICLE-SIZE DISTRIBUTION ANALYSIS



Sample code	D_{60}	D_{10}	U	Marking
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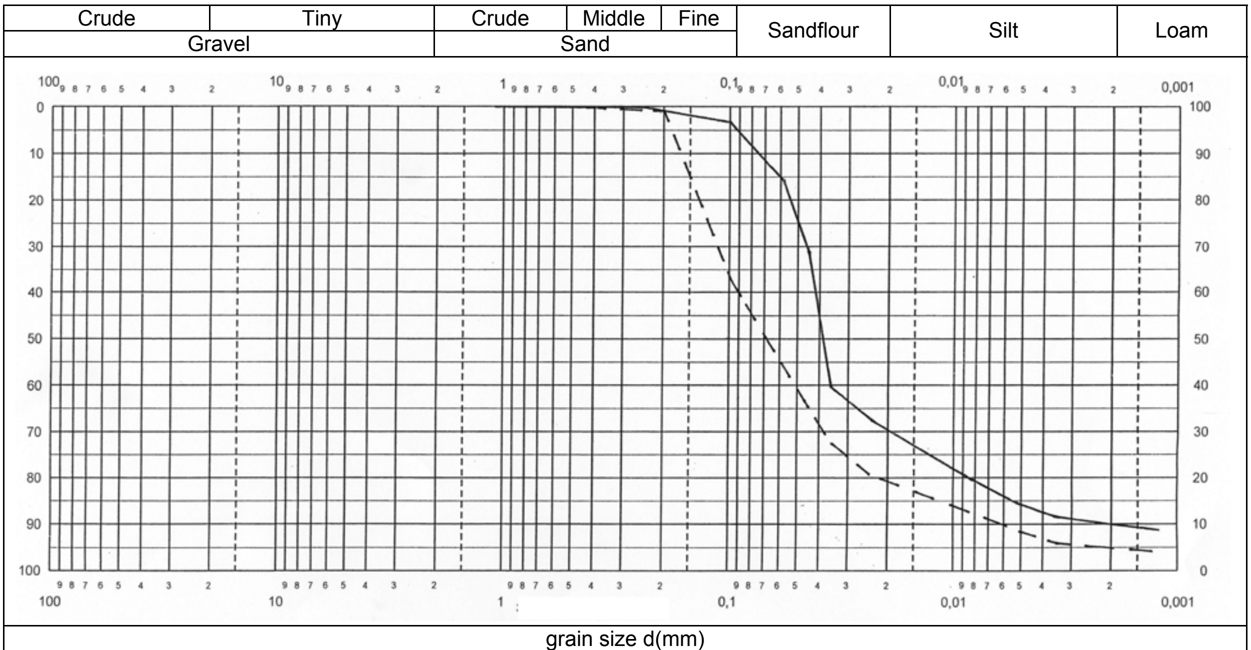
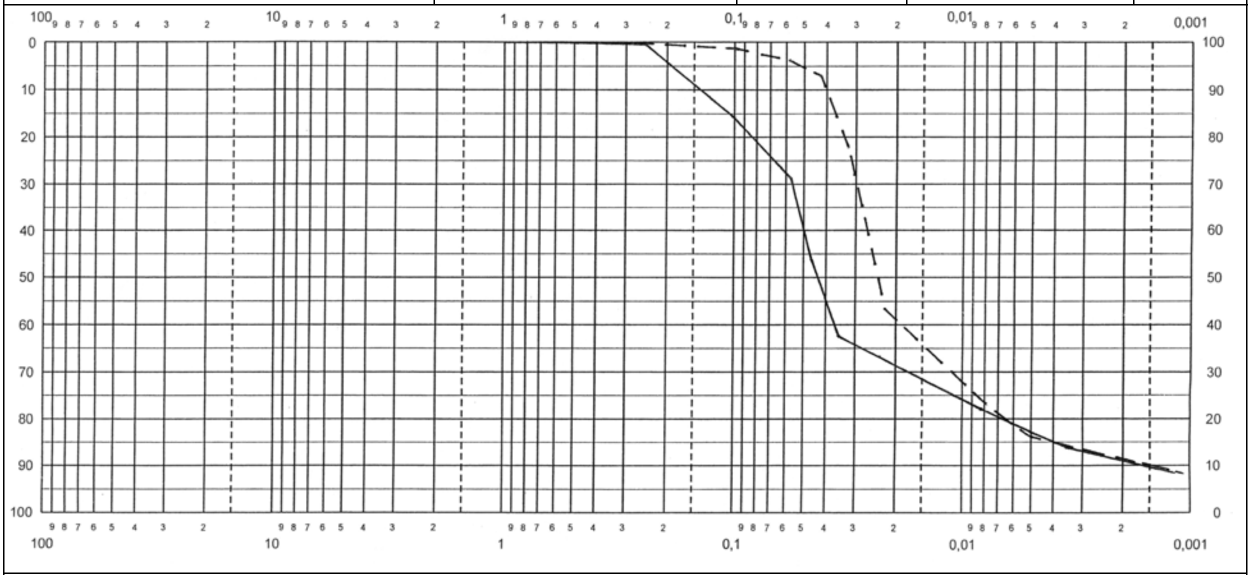
L-HU	0,040	0,0034	11,8	----------------



Sample code	D_{60}	D_{10}	U	Marking
2-1097 R-HU	0,041	0,0020	20,5	————————
L-HU	0,090	0,0060	15,0	----------------

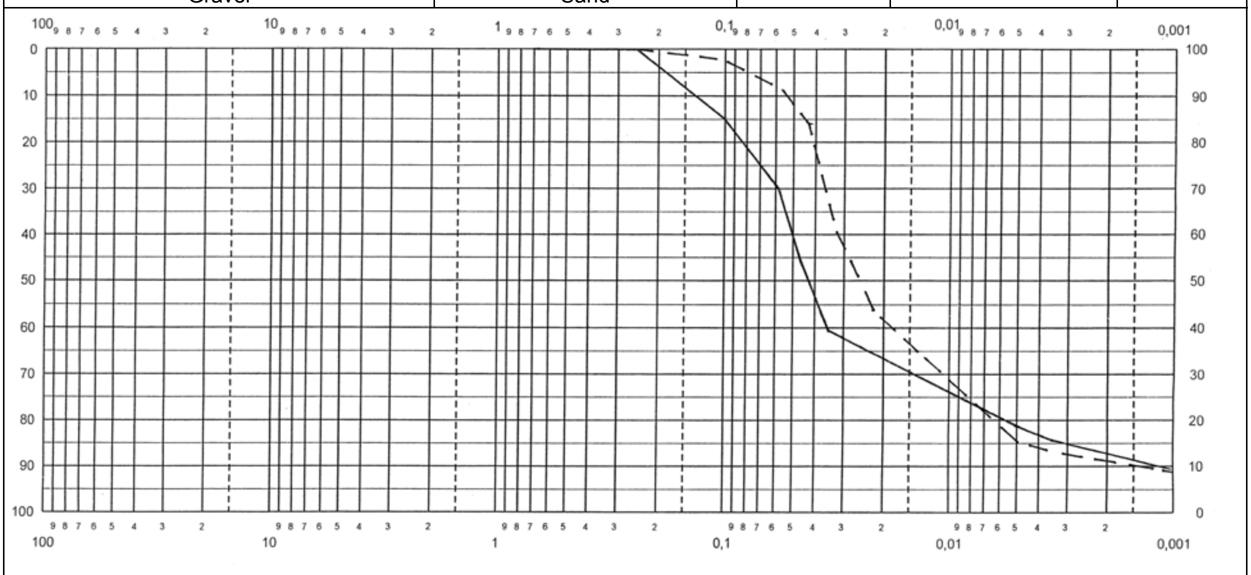
Crude	Tiny	Crude	Middle	Fine	Sandflour	Silt	Loam
Gravel		Sand					



grain size d(mm)

Sample code	D_{60}	D_{10}	U	Marking
3-1072 R-HU	0,050	0,0016	31,3	————————
L-HU	0,026	0,0015	17,3	----------------

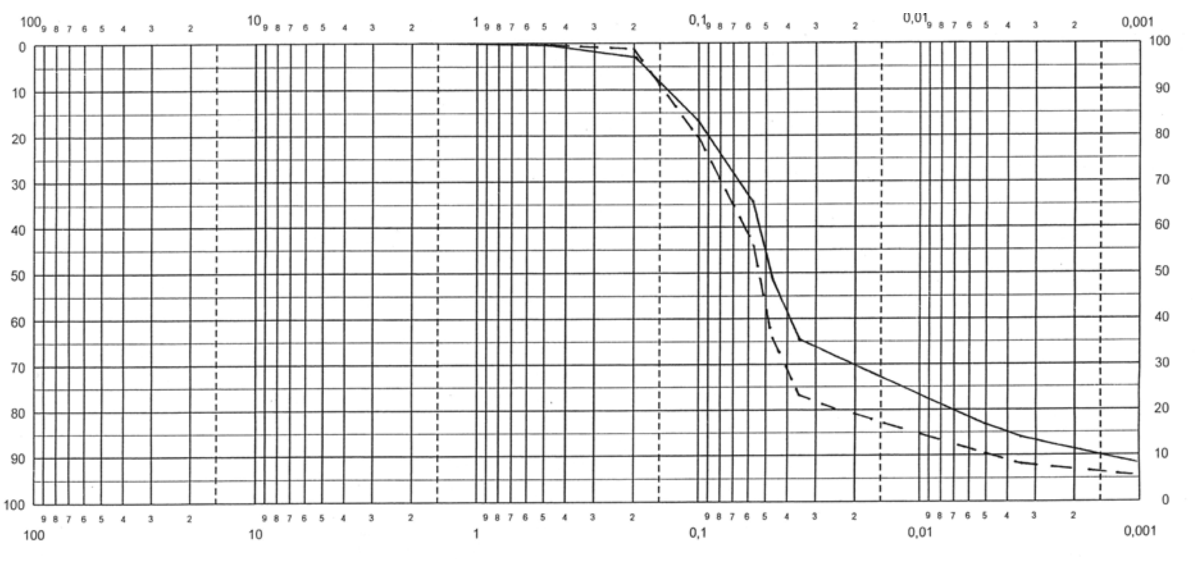
Crude	Tiny	Crude	Middle	Fine	Sandflour	Silt	Loam
Gravel		Sand					



grain size d(mm)

Sample code	D_{60}	D_{10}	U	Marking
4-1061 R-HU	0,050	0,0012	41,7	————————
L-HU	0,032	0,0014	22,9	----------------

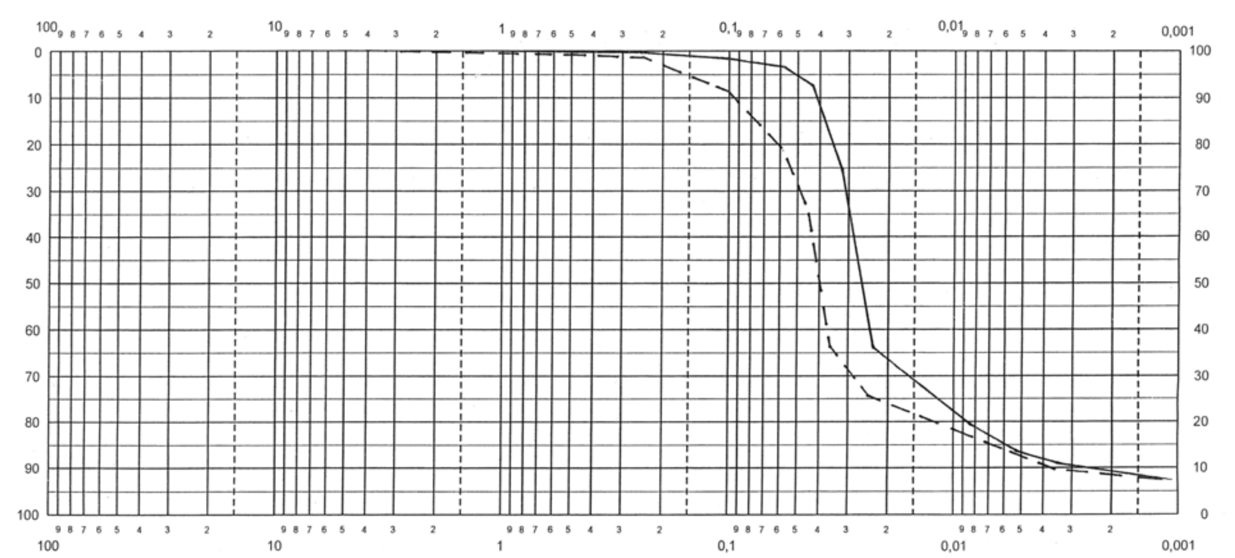
Crude	Tiny	Crude	Middle	Fine	Sandflour	Silt	Loam
Gravel		Sand					



grain size d(mm)

Sample code	D_{60}	D_{10}	U	Marking
5-1040 R-HU	0,053	0,0015	35,3	————————
L-HU	0,062	0,0048	12,9	----------------

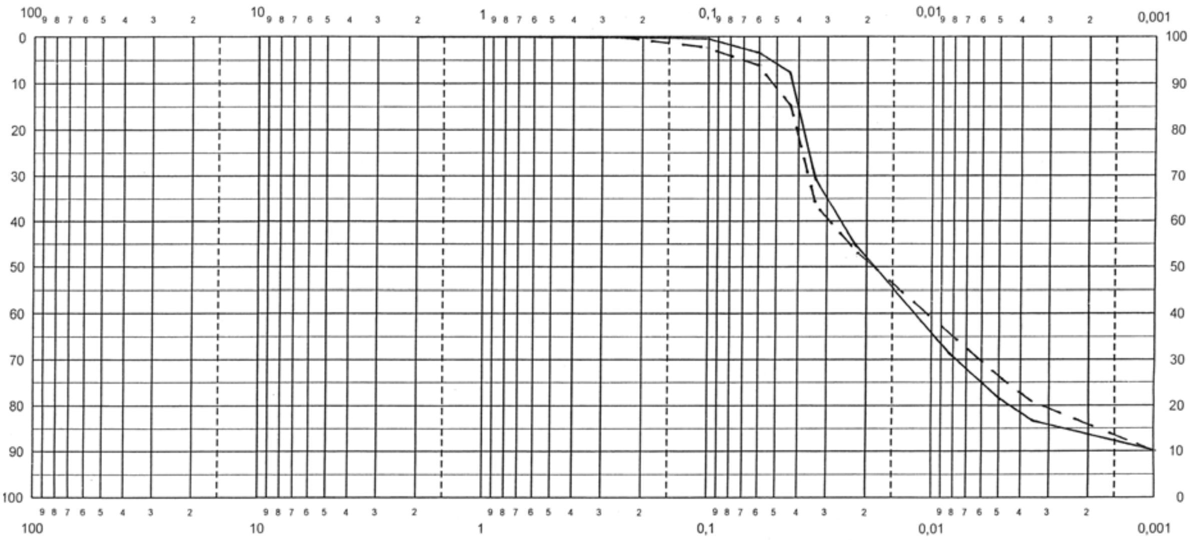
Crude	Tiny	Crude	Middle	Fine	Sandflour	Silt	Loam
Gravel		Sand					



grain size d(mm)

Sample code	D_{60}	D_{10}	U	Marking
6-1022 R-HU	0,028	0,0026	10,8	————————
L-HU	0,043	0,0037	11,6	----------------

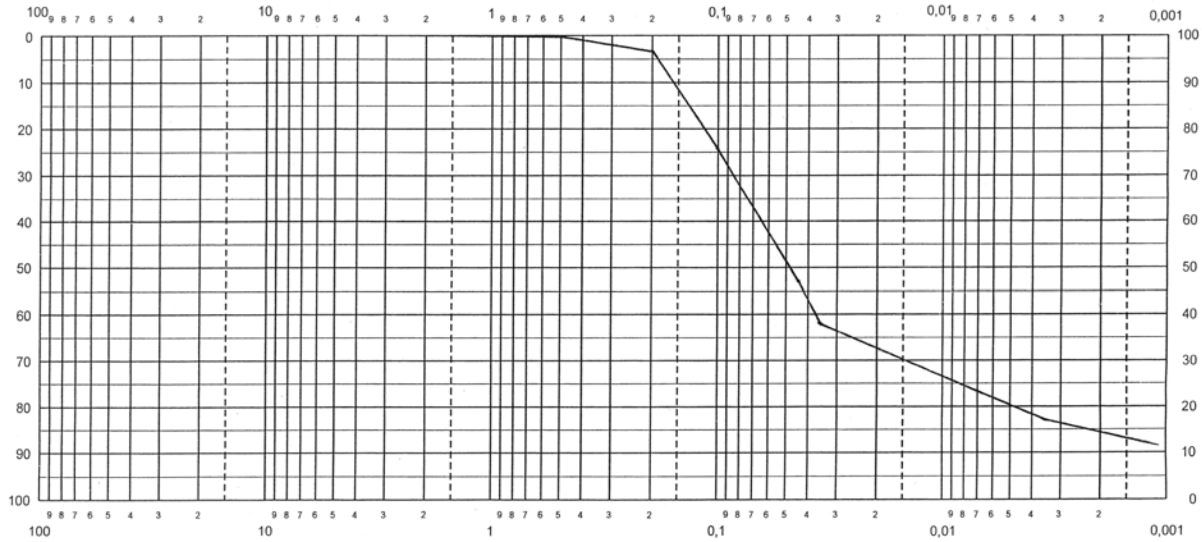
Crude	Tiny	Crude	Middle	Fine	Sandflour	Silt	Loam
Gravel		Sand					



grain size d(mm)

Sample code	D_{60}	D_{10}	U	Marking
7-990 R-HU	0,026	0,0010	26,0	———————
L-HU	0,030	0,0010	30,0	- - - - - - - - - -

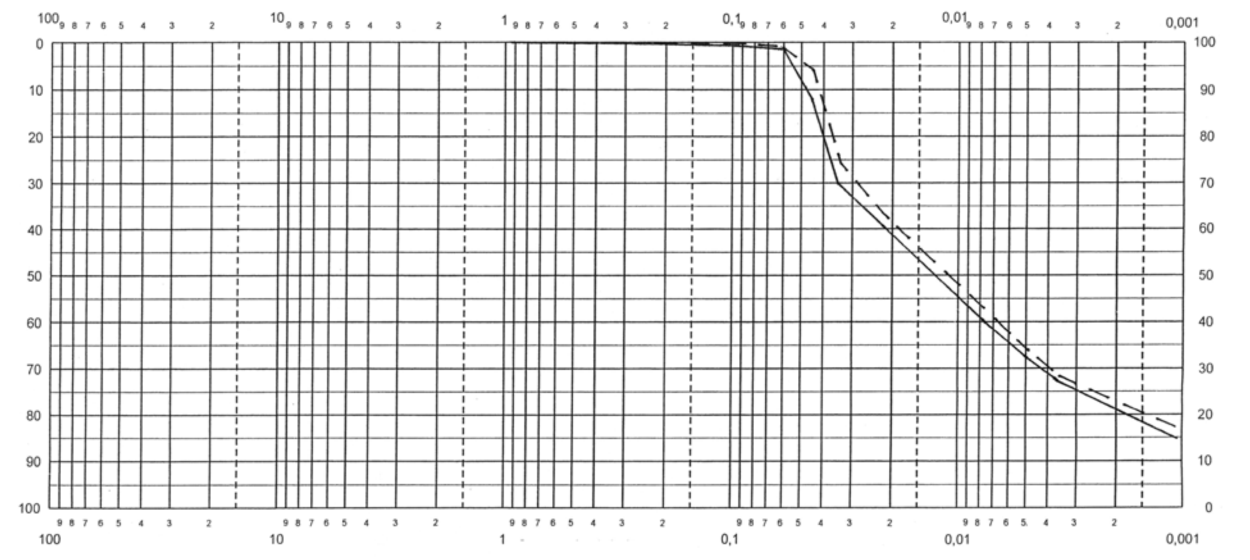
Crude	Tiny	Crude	Middle	Fine	Sandflour	Silt	Loam
Gravel		Sand					



grain size d(mm)

Sample code	D_{60}	D_{10}	U	Marking
8-971 R-HU	0,064	< 0,0010	> 64,0	———————

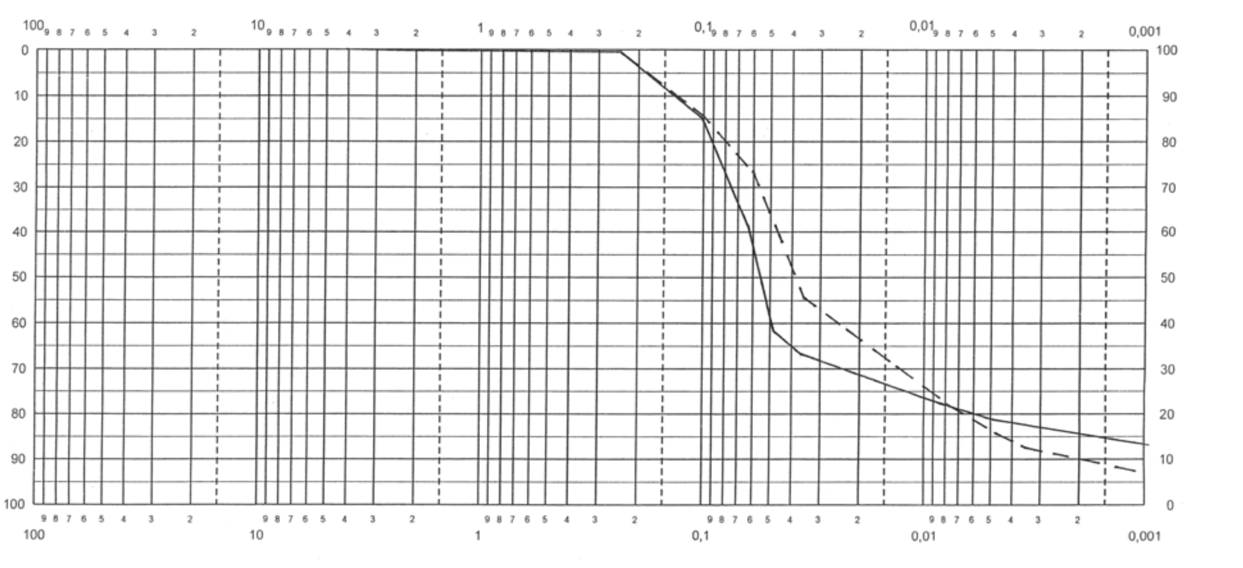
Crude	Tiny	Crude	Middle	Fine	Sandflour	Silt	Loam
Gravel		Sand					



grain size d(mm)

Sample code	D_{60}	D_{10}	U	Marking
9-956 R-HU	0,021	< 0,0010	> 21,0	————————
L-HU	0,018	< 0,0010	> 18,0	----------------

Crude	Tiny	Crude	Middle	Fine	Sandflour	Silt	Loam
Gravel		Sand					



grain size d(mm)

Sample code	D_{60}	D_{10}	U	Marking
10-924 R-HU	0,061	< 0,0010	> 61,0	————————
L-HU	0,046	0,0020	23,0	----------------

6 ANNEX 2: ANALYTICAL RESULTS OF THE SEDIMENT INVESTIGATION IN SEPT. 2006

(Institute for the development of water resources “jaroslav cerni”)

		1-1107 L	1-1107 R	2-1097 L	2-1097 R	3-1072 L	3-1072 R	4-1061 L	4-1061 R
location		**V. Morava - upstr**	**V. Morava - upstr**	**V. Morava - downstr**	**V. Morava - downstr**	**Ram**	**Ram**	**V. Gradiste**	**V. Gradiste**
Parameter	**Unit**								
Fluoranthene	µg/kg	17,9	26,3	<5,0	5,8	18,9	46,5	62,7	37,1
Benzo(b)fluoranthene	µg/kg	15,0	17,6	8,5	<5,0	16,5	24,5	28,1	13,1
Benzo(k)fluoranthene	µg/kg	10,7	13,2	<5,0	<5,0	11,8	17,1	17,3	6,6
Benzo(a)pyrene	µg/kg	12,9	17,6	<5,0	7,8	14,1	24,5	25,9	13,1
Indeno(c,d)pyrene	µg/kg	19,3	26,3	10,6	9,7	23,6	29,4	36,7	19,7
Benzo(g,h,i)perylene	µg/kg	17,2	22,0	12,7	9,7	23,6	19,6	32,4	17,5
PCB 28	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 52	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 101	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 118	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 138	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 152	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 180	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Aldrin	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Dieldrin	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Endrin	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
DDT (DDE+DDD)	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Lindane	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Octylphenol	µg/kg	+	+	+	+	+	+	+	+
Nonylphenol	µg/kg	+	+	+	+	+	+	+	+
Pentachlorphenol	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
TPH	µg/kg								
Di(2-ethyl-hexyl) phtalate	µg/kg	416,0	99,7	<10,0	<10,0	<10,0	495,6	143,5	179,9

		1-1107 L	1-1107 R	2-1097 L	2-1097 R	3-1072 L	3-1072 R	4-1061 L	4-1061 R
location		**V. Morava - upstr**	**V. Morava - upstr**	**V. Morava - downstr**	**V. Morava - downstr**	**Ram**	**Ram**	**V. Gradiste**	**V. Gradiste**
Hg	mg/kg	<0,4	<0,4	<0,4	<0,4	<0,4	<0,4	<0,4	<0,4
As	mg/kg	8,8	8,3	9,3	9,7	7,3	12,7	8,4	12,9
Cd	mg/kg	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0
Pb	mg/kg	44,5	44,6	42,9	60,2	47,6	60,2	46,7	71,8
Cu	mg/kg	57,4	48,3	58,3	44,0	58,7	55,8	58,3	55,5
Zn	mg/kg	214,9	252,5	221,8	232,9	229,8	281,3	233,4	270,7
Cr-tot.	mg/kg	35,2	45,4	38,2	63,5	37,7	53,1	37,6	68,3
Ni	mg/kg	37,0	60,0	42,7	103,0	41,5	70,9	43,2	105,2
total P	mg/kg	958,3	900,1	859,9	824,8	905,0	983,4	924,8	873,4
Organic N									
moisture, %		53,5	54,5	52,7	48,5	57,6	59,1	53,7	56,2
total N, %		0,23	0,22	0,27	0,21	0,25	0,25	0,28	0,24
PAHs									
Total	µg/kg	163,8	206,3	57,0	56,4	163,1	288,8	425,7	257,7
Naphtalene	µg/kg	<5,0	<5,0	<5,0	<5,0	<5,0	9,8	6,5	<5,0
Acenaphthylene	µg/kg	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0
Acenaphthene	µg/kg	8,6	13,2	6,3	7,8	11,8	22,0	25,9	24,0
Fluorene	µg/kg	12,9	<5,0	<5,0	<5,0	<5,0	<5,0	34,5	30,6
Phenantrene	µg/kg	12,9	21,9	<5,0	7,8	16,5	48,9	69,1	48,0
Anthracene	µg/kg	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0
Pyrene	µg/kg	15,0	21,9	6,3	7,8	18,9	36,7	45,4	28,4
Chryzene	µg/kg	6,4	8,8	4,2	<5,0	7,1	9,8	17,3	6,5
Benzo(a)anthracene	µg/kg	15,0	17,5	8,4	<5,0	<5,0	<5,0	23,8	13,1
Dibenzo(a,h)anthracene	µg/kg	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0
THC (C_{10} - C_{40}) ug/kg	µg/kg	49,4	82,5	47,7	21,7	26,9	35,7	20,5	32,3

		5-1040 L	5-1040 R	6-1022 L	6-1022 R	7-990 L	7-990 R	8-971 R	9-956 L	9-956 R	10-924 L	10-924 R
location		**Golubac**	**Golubac**	**Dobra**	**Dobra**	**D. Milanovac**	**D. Milanovac**	**Dubova**	**Tekija**	**Tekija**	**M. Vrbica**	**M. Vrbica**
Parameter	**Unit**											
Fluoranthene	µg/kg	45,2	<5,0	38,7	53,2	28,4	46,4	16,6	40,9	43,6	9,7	20,4
Benzo(b)fluoranthene	µg/kg	15,7	5,0	6,5	26,6	26,2	35,4	18,7	9,1	21,8	<5,0	8,7
Benzo(k)fluoranthene	µg/kg	11,8	<5,0	6,5	20,0	19,6	26,5	14,6	13,6	17,5	<5,0	8,7
Benzo(a)pyrene	µg/kg	15,7	7,5	12,9	24,4	24,0	33,2	<5,0	<5,0	<5,0	<5,0	14,6
Indeno(c,d)pyrene	µg/kg	19,7	<5,0	<5,0	28,8	28,4	35,4	18,7	20,5	24,0	<5,0	17,5
Benzo(g,h,i)perylene	µg/kg	17,7	<5,0	<5,0	24,4	24,0	30,9	16,6	15,9	15,9	<5,0	<5,0
PCB 28	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 52	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 101	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 118	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 138	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 152	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 180	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Aldrin	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Dieldrin	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Endrin	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
DDT (DDE+DDD)	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Lindane	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Octylphenol	µg/kg	+	+	+	+	+	+	+	+	+	+	+
Nonylphenol	µg/kg	+	+	+	+	+	+	+	+	+	+	+
Pentachlorphenol	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
TPH	µg/kg											
Di(2-ethyl-hexyl) phtalate	µg/kg	<10,0	233,2	<10,0	170,4	6615,1	6732,3	<10,0	<10,0	147,7	139,9	112,7
Hg	mg/kg	<0,4	<0,4	<0,4	<0,4	<0,4	<0,4	<0,4	<0,4	<0,4	<0,4	<0,4
As	mg/kg	17,1	12,2	7,5	12,2	9,3	9,1	9,6	10,0	7,9	5,8	10,8
Cd	mg/kg	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0
Pb	mg/kg	45,8	62,4	38,5	48,4	47,6	53,0	57,6	54,1	58,5	23,2	77,6
Cu	mg/kg	310,7	63,4	65,4	71,0	69,6	73,8	86,7	78,5	78,3	40,9	104,8
Zn	mg/kg	218,3	295,8	178,3	252,9	237,9	265,2	280,8	291,1	279,3	101,1	340,7

		5-1040 L	5-1040 R	6-1022 L	6-1022 R	7-990 L	7-990 R	8-971 R	9-956 L	9-956 R	10-924 L	10-924 R
location		**Golubac**	**Golubac**	**Dobra**	**Dobra**	**D. Milanovac**	**D. Milanovac**	**Dubova**	**Tekija**	**Tekija**	**M. Vrbica**	**M. Vrbica**
Cr-tot.	mg/kg	29,3	56,7	36,3	43,5	46,9	52,2	46,6	57,8	57,4	25,1	59,7
Ni	mg/kg	33,4	77,3	39,8	53,2	60,2	70,1	55,7	68,2	68,3	37,8	72,9
total P	mg/kg	721,7	984,3	989,2	922,8	851,3	833,3	950,5	932,4	861,9	638,9	1164,8
Organic N												
moisture, %		49,2	59,8	53,5	54,9	54,2	54,8	51,9	56,0	54,2	48,7	65,7
total N, %		0,16	0,26	0,28	0,26	0,22	0,17	0,19	0,27	0,21	0,19	0,34
PAHs												
Total	µg/kg	393,1	59,8	221,5	379,3	377,6	477,5	239,2	256,9	277,7	74,3	177,6
Naphtalene	µg/kg	11,8	17,4	<5,0	<5,0	126,6	134,8	70,7	9,1	6,5	5,8	8,7
Acenaphthylene	µg/kg	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0
Acenaphthene	µg/kg	27,5	7,5	25,8	24,4	13,1	11,0	6,2	20,5	17,5	11,7	17,5
Fluorene	µg/kg	33,4	9,9	32,3	33,3	<5,0	17,7	<5,0	27,3	24,0	<5,0	23,3
Phenantrene	µg/kg	59,0	<5,0	53,8	59,9	17,5	26,5	25,0	40,9	39,3	31,2	23,3
Anthracene	µg/kg	76,7	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0
Pyrene	µg/kg	33,4	<5,0	25,8	39,9	28,4	44,2	18,7	31,8	43,9	15,6	20,4
Chryzene	µg/kg	9,8	5,0	6,4	17,8	16,3	<5,0	12,5	6,8	8,7	<5,0	5,8
Benzo(a)anthracene	µg/kg	15,7	7,5	12,9	26,6	26,2	35,4	20,8	20,5	24,0	<5,0	8,7
Dibenzo(a,h)anthracene	µg/kg	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0
THC (C_{10} - C_{40}) ug/kg	µg/kg	25,4	26,8	397,8	<5,0	27,1	14,8	27,2	26,8	15,1	61,0	33,5

		core 991-R	core 991-R	core 991-R	core 991-R	core 991-R	core 991-R	core 991-R
		10	20	30	40	50	60	67
location		**D. Milanovac**	**D. Milanovac**	**D. Milanovac**	**D. Milanovac**	**D. Milanovac**	**D. Milanovac**	**D. Milanovac**
Parameter	**Unit**							
Fluoranthene	µg/kg	13,7	<5,0	5,3	40,7	38,2	34,7	70,3
Benzo(b)fluoranthene	µg/kg	8,6	<5,0	<5,0	27,9	25,5	26,0	36,1
Benzo(k)fluoranthene	µg/kg	<5,0	<5,0	<5,0	27,9	21,3	23,9	34,3
Benzo(a)pyrene	µg/kg	8,6	7,3	7,1	25,7	25,5	15,2	34,3
Indeno(c,d)pyrene	µg/kg	6,9	7,3	5,3	21,4	23,3	21,7	32,5
Benzo(g,h,i)perylene	µg/kg	6,9	5,4	5,3	19,3	17,0	19,5	27,0
PCB 28	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 52	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 101	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 118	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 138	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 152	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 180	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Aldrin	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Dieldrin	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Endrin	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
DDT (DDE+DDD)	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Lindane	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Octylphenol	µg/kg	+	+	+	+	+	+	+
Nonylphenol	µg/kg	+	+	+	+	+	+	+
Pentachlorphenol	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
TPH	µg/kg							
Di(2-ethyl-hexyl) phtalate	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	21,5
Hg	mg/kg	<0,4	<0,4	<0,4	<0,4	<0,4	<0,4	<0,4
As	mg/kg	7,6	8,5	8,0	13,7	12,5	15,6	16,2
Cd	mg/kg	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0
Pb	mg/kg	27,8	49,6	49,2	98,6	102,5	53,9	44,5
Cu	mg/kg	50,7	70,2	77,0	143,9	146,5	159,1	128,4
Zn	mg/kg	150,5	228,7	217,3	424,5	405,4	447,1	281,3
Cr-tot.	mg/kg	48,4	48,6	52,2	66,5	68,3	73,4	71,2
Ni	mg/kg	70,4	63,5	65,6	65,0	68,5	71,0	79,3
total P, mg/kg	mg/kg	628,8	753,3	685,9	922,0	955,2	942,0	768,3
Organic N								
moisture, %		41,8	44,9	43,9	53,4	52,9	53,9	44,5
total N, %		0,13	0,16	0,15	0,26	0,27	0,26	0,12

		core 991-R	core 991-R	core 991-R	core 991-R	core 991-R	core 991-R	core 991-R
		10	**20**	**30**	**40**	**50**	**60**	**67**
location		**D. Milanovac**	**D. Milanovac**	**D. Milanovac**	**D. Milanovac**	**D. Milanovac**	**D. Milanovac**	**D. Milanovac**
PAHs								
Total	µg/kg	114,8	58,1	55,0	334,5	290,8	273,5	468,9
Naphtalene	µg/kg	5,1	<5,0	<5,0	6,4	6,4	6,5	5,4
Acenaphthylene	µg/kg	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	5,4
Acenaphthene	µg/kg	10,3	5,4	5,3	10,7	10,6	10,8	16,2
Fluorene	µg/kg	13,7	7,3	7,1	17,1	17,0	15,2	21,6
Phenantrene	µg/kg	13,7	<5,0	<5,0	40,7	21,2	13,0	41,5
Anthracene	µg/kg	<5,0	<5,0	<5,0	6,4	6,4	6,5	10,8
Pyrene	µg/kg	12,0	12,7	8,9	38,6	38,2	32,6	59,5
Chryzene	µg/kg	5,1	5,4	<5,0	21,4	10,5	19,5	28,9
Benzo(a)anthracene	µg/kg	10,3	7,3	10,7	30,0	29,7	28,2	39,7
Dibenzo(a,h)anthracene	µg/kg	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	5,4
THC (C_{10} - C_{40}) ug/kg	µg/kg	6,5	11,1	15,9	83,8	65,2	59,3	48,1

		core 956-R	core 956-R	core 956-R	core 956-R	core 956-R	core 956-R	core 956-R	core 956-R
		10	**20**	**30**	**40**	**50**	**60**	**70**	**82**
location		**Tekija**	**Tekija**	**Tekija**	**Tekija**	**Tekija**	**Tekija**	**Tekija**	**Tekija**
Parameter	**Unit**								
Fluoranthene	µg/kg	12,6	92,1	55,7	38,3	54,7	122,8	57,9	168,3
Benzo(b)fluoranthene	µg/kg	6,3	35,1	27,8	19,1	28,5	57,9	26,7	76,2
Benzo(k)fluoranthene	µg/kg	10,5	28,5	20,9	17,0	24,1	46,3	24,5	65,5
Benzo(a)pyrene	µg/kg	10,5	32,9	25,9	19,1	26,3	60,2	22,3	70,9
Indeno(c,d)pyrene	µg/kg	10,5	35,1	<5,0	19,1	21,9	44,0	20,0	51,4
Benzo(g,h,i)perylene	µg/kg	8,4	26,3	20,9	14,9	19,7	39,4	17,8	40,7
PCB 28	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 52	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 101	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 118	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 138	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 152	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 180	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Aldrin	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Dieldrin	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Endrin	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0

		core 956-R	core 956-R	core 956-R	core 956-R	core 956-R	core 956-R	core 956-R	core 956-R
		10	**20**	**30**	**40**	**50**	**60**	**70**	**82**
location		**Tekija**	**Tekija**	**Tekija**	**Tekija**	**Tekija**	**Tekija**	**Tekija**	**Tekija**
DDT (DDE+DDD)	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Lindane	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Octylphenol	µg/kg	+	+	+	+	+	+	+	+
Nonylphenol	µg/kg	+	+	+	+	+	+	+	+
Pentachlorphenol	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
TPH	µg/kg								
Di(2-ethyl-hexyl) phtalate	µg/kg	<10,0	126,5	193,7	<10,0	<10,0	68,8	<10,0	298,0
Hg	mg/kg	<0,4	<0,4	<0,4	<0,4	<0,4	<0,4	<0,4	<0,4
As	mg/kg	10,1	11,6	12,5	12,8	12,1	12,5	15,4	16,6
Cd	mg/kg	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0
Pb	mg/kg	52,4	54,4	56,9	53,0	54,3	56,8	55,1	43,5
Cu	mg/kg	81,6	82,9	94,2	102,8	117,6	131,4	151,9	153,1
Zn	mg/kg	300,7	324,4	329,4	323,5	389,8	391,6	463,3	439,3
Cr-tot.	mg/kg	52,4	53,0	54,5	57,5	58,9	63,2	68,8	74,1
Ni	mg/kg	65,8	67,1	65,6	65,1	60,0	63,9	62,8	65,4
total P, mg/kg	mg/kg	1028,4	1082,9	1039,2	974,7	1060,0	1089,0	1202,9	1158,5
Organic N									
moisture, %		52,4	54,4	56,9	53,0	54,3	56,8	55,1	43,5
total N, %		0,24	0,27	0,25	0,23	0,25	0,29	0,27	0,28
PAHs									
Total	µg/kg	130,4	572,1	353,1	300,1	635,7	792,4	356,4	976,0
Naphtalene	µg/kg	<5,0	15,3	9,3	6,4	6,6	13,9	6,7	8,9
Acenaphthylene	µg/kg	<5,0	<5,0	<5,0	<5,0	<5,0	6,9	<5,0	8,9
Acenaphthene	µg/kg	8,4	35,1	23,2	14,9	17,5	34,7	13,4	19,5
Fluorene	µg/kg	12,6	46,0	30,2	21,2	24,1	44,0	17,8	28,3
Phenantrene	µg/kg	12,6	83,3	51,0	53,2	43,8	101,9	31,2	95,7
Anthracene	µg/kg	<5,0	11,0	7,0	6,4	8,8	13,9	8,9	21,3
Pyrene	µg/kg	16,8	67,9	41,7	31,9	46,0	99,6	55,7	138,2
Chryzene	µg/kg	6,3	24,1	9,3	14,9	10,9	41,7	15,6	62,0
Benzo(a)anthracene	µg/kg	14,7	39,5	30,2	23,4	32,8	64,8	37,9	90,3
Dibenzo(a,h)anthracene	µg/kg	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0
THC (C_{10} - C_{40}) ug/kg	µg/kg	63,5	40,1	45,5	37	23,6	50,3	54,8	34,5

		core 924 R	core 924 R	core 924 R	core 924 R	core 924 R	core 924 R	core 924 R	core 924 R
		10	**20**	**30**	**40**	**50**	**60**	**70**	**80**
location		**M. Vrbica**	**M. Vrbica**	**M. Vrbica**	**M. Vrbica**	**M. Vrbica**	**M. Vrbica**	**M. Vrbica**	**M. Vrbica**
Parameter	**Unit**								
Fluoranthene	µg/kg	59,6	90,1	58,0	74,1	56,3	69,3	97,1	113,9
Benzo(b)fluoranthene	µg/kg	25,2	36,0	25,2	31,4	22,5	28,7	34,7	48,5
Benzo(k)fluoranthene	µg/kg	20,6	25,7	20,2	26,9	18,0	23,9	27,8	40,1
Benzo(a)pyrene	µg/kg	25,2	33,5	25,2	29,2	20,3	26,3	32,4	23,1
Indeno(c,d)pyrene	µg/kg	20,6	28,3	<5	24,7	<5	21,5	23,1	40,1
Benzo(g,h,i)perylene	µg/kg	11,4	90,1	<5,0	20,2	<5,0	16,7	23,1	33,8
PCB 28	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 52	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 101	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 118	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 138	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 152	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
PCB 180	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Aldrin	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Dieldrin	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Endrin	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
DDT (DDE+DDD)	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Lindane	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
Octylphenol	µg/kg	+	+	+	+	+	+	+	+
Nonylphenol	µg/kg	+	+	+	+	+	+	+	+
Pentachlorphenol	µg/kg	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0	<10,0
TPH	µg/kg								
Di(2-ethyl-hexyl) phtalate	µg/kg	167,0	399,7	<10,0	18,2	<10,0	<10,0	<10,0	<10,0
Hg	mg/kg	<0,4	<0,4	<0,4	<0,4	<0,4	<0,4	<0,4	<0,4
As	mg/kg	9,6	6,7	7,6	9,0	8,8	9,8	10,6	8,9
Cd	mg/kg	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0
Pb	mg/kg	56,3	50,5	57,0	65,6	60,1	73,4	63,4	64,1
Cu	mg/kg	69,2	62,6	65,3	84,5	74,5	84,6	79,6	65,8
Zn	mg/kg	247,4	252,9	262,3	301,0	270,1	294,1	268,3	278,5
Cr-tot.	mg/kg	42,6	41,5	43,6	49,2	43,9	51,2	46,3	47,0
Ni	mg/kg	55,9	50,5	50,9	51,9	45,0	55,7	50,4	52,9
total P, mg/kg	mg/kg	1081,3	1120,3	1130,8	1163,5	1215,7	1202,8	1327,8	1580,5
Organic N									
moisture, %		56,3	61,2	60,3	55,5	55,6	58,2	56,8	59,6
total N, %		0,30	0,30	0,30	0,25	0,29	0,30	0,27	0,25
PAHs									

		core 924 R	core 924 R	core 924 R	core 924 R	core 924 R	core 924 R	core 924 R	core 924 R
		10	**20**	**30**	**40**	**50**	**60**	**70**	**80**
location		**M. Vrbica**	**M. Vrbica**	**M. Vrbica**	**M. Vrbica**	**M. Vrbica**	**M. Vrbica**	**M. Vrbica**	**M. Vrbica**
Total	µg/kg	384,9	620,7	370,7	471,7	339,9	425,6	587,6	668,9
Naphtalene	µg/kg	11,4	12,9	20,2	9,0	11,3	21,5	25,4	12,7
Acenaphthylene	µg/kg	6,9	7,7	7,6	<5,0	6,7	7,2	11,6	8,4
Acenaphthene	µg/kg	16,0	28,3	22,7	20,2	20,3	23,9	25,4	23,1
Fluorene	µg/kg	22,9	38,6	27,7	29,2	27,0	<5,0	37,0	35,9
Phenantrene	µg/kg	48,1	82,4	53,0	60,6	54,0	66,9	92,5	101,3
Anthracene	µg/kg	11,4	12,9	10,1	9,0	9,0	9,6	13,9	14,8
Pyrene	µg/kg	43,5	74,7	53,0	67,4	59,5	62,2	81,0	101,3
Chryzene	µg/kg	25,2	15,4	17,6	26,9	15,8	12,0	16,2	10,5
Benzo(a)anthracene	µg/kg	36,7	43,8	30,3	42,7	29,3	35,9	46,3	61,2
Dibenzo(a,h)anthracene	µg/kg	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0	<5,0
THC (C_{10} - C_{40}) ug/kg	µg/kg	10,3	<5,0	<5,0	14,8	18,2	15,5	11,8	27,2

"+" means present (by comparison with mass spectra library), not quantified due to lack of standard