PART II
THE REMP - CORE PLAN

CHAPTER 5
ACTIVITIES AFFECTING THE ENVIRONMENT, STATE OF THE ENVIRONMENT, MAIN ISSUES AND RECOMMENDATIONS

5.1 SURFACE WATER

5.1.1 SOURCES OF SURFACE WATER POLLUTION

(1) Available data of sources of surface water pollution

Pollutant discharges to water in the Hron basin are from the following sources: (Figure 5.1-2)

- Municipal wastewater (treated or untreated)
- Industrial wastewater (treated or untreated)
- Mining effluents
- Agricultural activities
- Solid waste disposal (industry, mining, domestic wastes)

Sources of surface water pollution from agriculture and solid waste disposal are described in Sections 5.2 and 5.4, respectively. In this section, wastewater sources are discussed.

As shown in Table 5.1-1, according to the information from Povodie Hrona, there are an estimated 300 sources of wastewater effluent in the Study Area in 1999. 126 of these waste water effluent sources monitored by SHMU. These Monitored wastewater effluent sources using a GIS location map (scale: 1:50 000) and their characteristics have been identified as shown in Supporting Report - Annex E.2.

Table 5.1 - 1 List of Sources of Surface Water Pollution

Classification of pollutant sources		Most important sources	New registered sources of pollutions	Cancelled or not important sources of pollution without numbering	Unknown sources	Total
Data List provided by Povodie Hrona in 1999	Number of Pollutant discharges	122	145	36	6	309
	%	39	47	12	2	100
	municipal	64	36	—	—	—
	(%)	52	25			
	industry	52	53	—	—	—
	(%)	43	37			
	transport	4	20	—	—	—
	(%)	3	14			
	agriculture	2	16	—	—	—
	(%)	2	11			
	unknown	0	20	—	—	—
	(%)	0	14			
Monitoring data by SHMU in 1997	Number of Monitoring Point	88	26	10	6	130
	(%)	68	20	8	5	100

Source: Based on the data provided by SHMU (1997) and Povodie Hrona (1999)

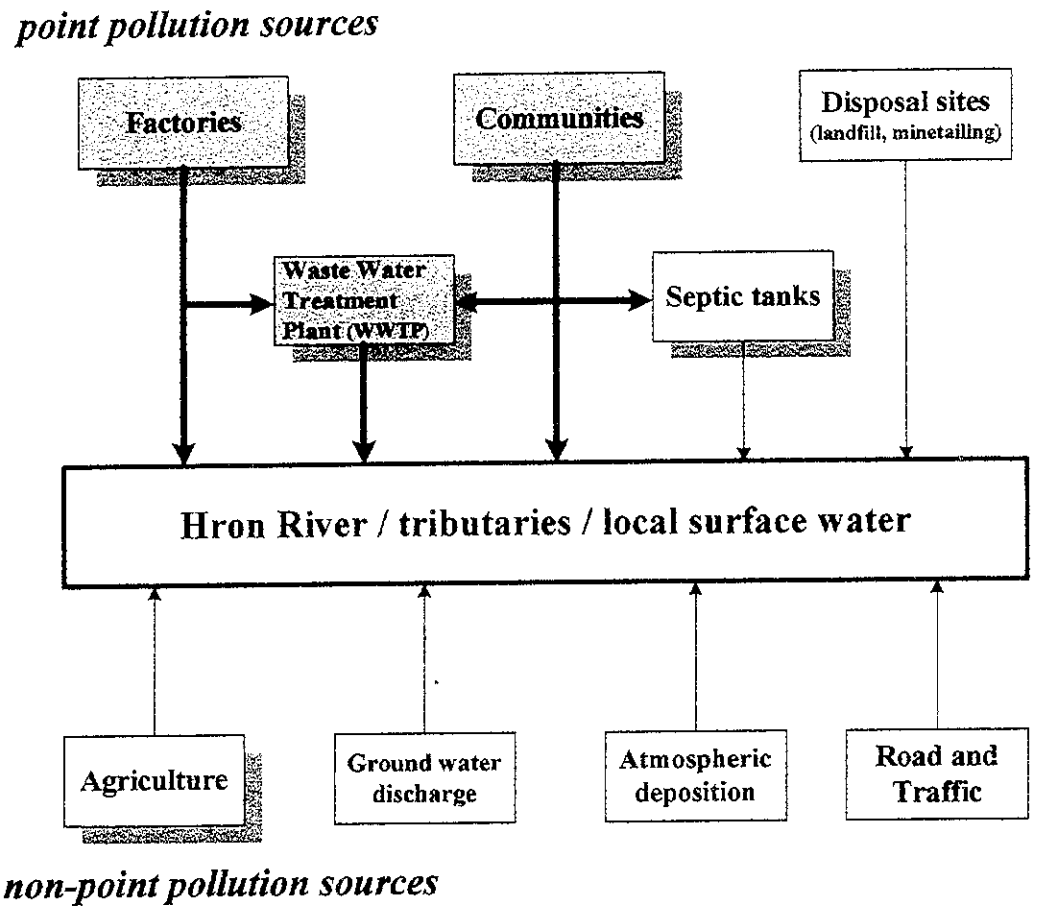


Figure 5.1 - 1 Identified Sources of Surface Water Pollution in the Study Area Source:Digital data provided by SHMU

The Study Team analyzed data obtained from SHMU containing information on the 126 monitored wastewater effluent sources for the year 1982 to 1997. However, because this information in this data set was limited, the Study Team was only able to classify these sources into following 4 categories:

- wastewater treatment plants managed by waterworks (many of these receive domestic and industrial waste water)
- industrial wastewater treatment plants.
- other discharges in municipalities
- agricultural farm (animals)

The monitored effluent sources are listed according to the above categories in the Supporting Report-Annex E.2. Figure 5.1-2 shows number and amount of wastewater discharges according to the SHMU data (SHMU BA 3) since 1982. However, it is difficult to interpret this Figure in terms of trends in wastewater discharged over this period because the SHMU database records information from different numbers of wastewater effluents in each year. The discharge figures are considered to be dependent on the number of effluent sources monitored in each year.

Location of waste water effluent sources of known to Povodie Hrona on a GIS map (scale: 1:50,000) and their characteristics have been identified and were classified into the following 3 categories:

- most important sources of pollution
- new registered sources of pollution
- cancelled or not important sources of pollution

Among these 3 categorized sources of pollution, 212 points are identified the location with x-y coordinate and characteristics as shown in Map 5.1-1a and Map 5.1-1b.

(2) Characteristics of the Main Polluters

According to the comparison of BOD_5 load (t/yr) of each effluent sources from SHMU monitoring data in 1997, the main polluters in the Study Area are municipal and industrial wastewater effluents as shown in Table 5.1-2. The characteristics of highlighted polluters is summarized as follows (Ref. 1-22).

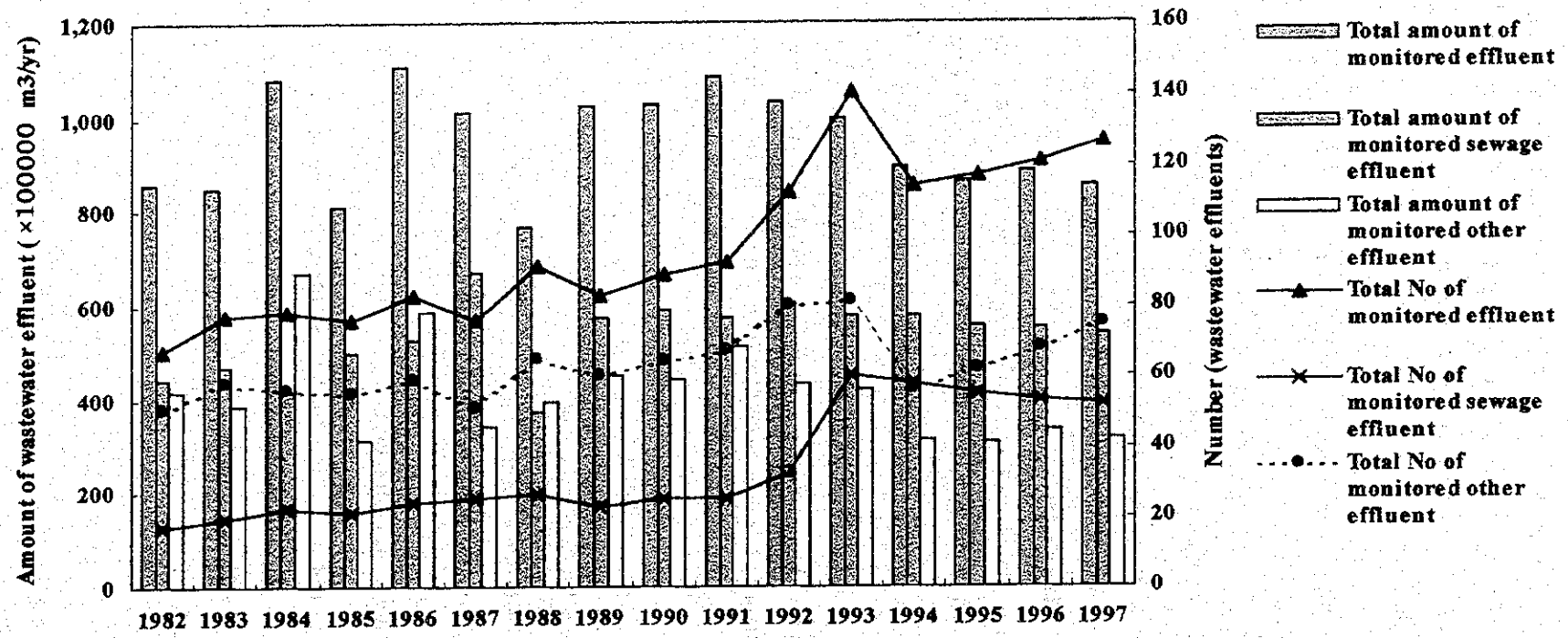


Figure 5.1 - 2 Number and Amount of Wastewater Effluents in the Study Area (1982 – 1997)

Source: Based on the digital data provided by SHMU

Table 5.1 - 2 List of Major Polluters and Effluent Characteristics in the Study Area

Ranking	Name	Type of pollution	Type of activity	River (km)	Recipient	Monitored data of effluent in 1997		Average concentration of BOD_5 (mg/l)	Government Order No. 242/1993 Coll. of Laws
						Total Quantity (t/yr)	Total BOD_5 (t/yr)		
1	StVak -VK BB effluent of WW to Hron	municipal	WWTP	168.4	Hron	17 660 160	794.71	45.0	35.0
2	ZsVak VK Levice effluent of WW to Hron	municipal	sewerage	2.2	Podlužianka	12 929 760	310.31	24.0	35.0
3	Biotika Slov.Lupca effluent of WW to the Hron	industry	pharmacy	183.8	Hron	1 172 800	189.99	162.0	50.0
4	Harmanecke paper factory Harmanec effluent	industry	paper-industry	9.8	Selčiansky creek-1	1 639 440	131.16	80.0	50.0
5	StVak VK Zvolen effluent of WW to Hron	municipal	sewerage	153.3	Hron	7 884 000	78.84	10.0	35.0
6	StVak - VK Brezno effluent of WW - Hron	municipal	sewerage	218.6	Hron	4 099 680	41.00	10.0	45.0
7	Biotika Slov.Lupca effluent of cold waters to the Hron	industry	pharmacy	183.8	Hron	7 884 000	36.27	4.6	50.0
8	ZSNP Ziar nad Hronom effluent of WW to Hron (B)	industry	smelting	125.3	Hron	725 328	32.17	44.4	-
9	Bucina Zvolen effluent of WW to Slatina	industry	wood-processing	3.7	Hodrušský creek	58 600	27.15	463.3	50.0
10	Bucina Zvolen effluent of ww to Zolna	industry	wood-processing	1.1	Sikenica	3 154	24.80	7863.0	50.0
11	StVak VK Zvolen effluent of WW from WTP to Hron	municipal	sewerage	152.0	Hron	473 040	23.65	50.0	50.0
12	Petrochema Dubova effluent of WW to the Hron	industry	petro-chemical industry	203.5	Hron	1 395 792	20.94	15.0	50.0
13	ZsVak VK Tlmace effluent of WW to Hron	municipal	energetic industry	73.4	Hron	473 040	20.34	43.0	50.0
14	StVak VK Kremnica effluent of WW to Kremnicky potok	municipal	sewerage	15.0	Kremnický creek-1	283 824	17.03	60.0	50.0
15	Preglejka Zarnovica effluent of WW to Hron	industry	wood-processing	0.0	Slatina-1	160 243	16.32	101.8	50.0
16	StVak - VK Valaska effluent of WW - Hron	municipal	sewerage	0.5	Cierny Hron	315 360	15.14	48.0	50.0
17	StVak VK Selce effluent of industrial waste to Selciansky brook (B)	municipal	sewerage	2.6	Selčiansky creek-1	173 448	14.74	85.0	50.0
18	StVak VK Ziar nad Hronom effluent of WW to Hron	municipal	sewerage	126.8	Hron	2 365 200	14.19	6.0	45.0
19	Municipality Podbrezova effluent of WW to Hron	municipal	sewerage	214.4	Hron	378 432	14.00	37.0	80.0
20	AEMO Nuclear power plant Mochovce elifuent of WW	industry	power-plant	73.5	Hron	1 522 100	11.87	7.8	50.0
21	ZsVak VK Zeliezovce effluent of WW to Vrbovec	municipal	sewerage	1.5	Vrbovec-1	536 112	11.26	21.0	50.0
22	Bucina Zvolen effluent of WW to Hron	industry	wood-processing	153.8	Hron	43 200	11.23	260.0	50.0
23	ZSNP Ziar nad Hronom effluent of WW to Hron (A)	industry	smelting	128.9	Hron	2 680 560	10.72	4.0	50.0
24	StVak VK Kremnica effluent of WW to Kremnicky potok	municipal	sewerage	13.5	Kremnický creek-1	94 608	10.41	110.0	50.0
25	StVak VK Detva effluent of WW fromn WTP from Slatina	municipal	sewerage	28.6	Slatina-1	1 702 944	10.22	6.0	45.0

Source: Based on the data provided by SHMU (1997) and Povodie Hrona (1999)

1) Municipal wastewater (treated and untreated)

The biggest water pollution source in the Study Area is the municipal wastewater (public sewer) particularly from the city of Banská Bystrica which has high organic contamination production. Elimination of municipal waste water in the district cities of Banská Bystrica, Brezno, Zvolen and Ziar nad Hronom is carried out through WWTP, which are under management of StVak (Central-Slovak Water pipes and Sewers). The city of Zarnovica, however, discharges municipal waste water into an industrial WWTP Preglejka, Inc., Zarnovica.

Other sites in the Study Area, which dispose and eliminate waste water through a sewer system to the WWTP are Valaská (WWTP Brezno - StVak, WWTP Valaská - StVak, WWTP Valaská - OcÚ), Podbrezová (WWTP Podbrezová - StVak, WWTP Podbrezová – OcÚ (part Bowling hall, Šupková, Bendicka, Smreková, and waste water from Iron works Inc., old part of the plant) , Medzibrod (WWTP OcÚ), Lieskovec (WWTP 20%, OcÚ), Kovácová (WWTP Zvolen - StVak re-directed waste water), Budca (WWTP OcÚ), Ladomerská Vieska (WWTP OcÚ) and Nová Bana (WWTP StVak).

2) Industrial wastewater (treated and untreated)

The Study Area is typical for its considerable diversification of industrial production in the following most important sectors:

- Metallurgy (Ziar nad Hronom, Brezno)
- Machinery (Brezno, Banská Bystrica, Zvolen)
- Wood-processing industry (Banská Bystrica, Zvolen, Ziar nad Hronom)
- Chemical and pharmaceutical industry (Brezno, Banská Bystrica)
- Food industry (Zvolen, Banská Bystrica)

Outlines of some of most significant industrial sources of water pollution are given below.

Biotika Slovenská Lupca, Inc.

This company focuses on antibiotic and amino acid production related to penicillin, lynzin, chlortetracycline, dextran, and biofactor supplements for veterinary purposes. In the company, there are 2 outlets for waste water discharging, industrial, technologic, and sewage water. After preliminary treatment, this is discharged to the MB COV and then on into the Hron via the Istebník stream. Cooling water is discharged through the second outlet via the trunk sewage canal.

Waste water discharge from BIOTIKA is permitted under the Resolution n. 1012/2/436/94 - Z of 26.9.1994 OÚZP Banská Bystrica. A considerable portion of waste water from this industrial installation consists of organic contaminants. This water, together with sewage water is discharged through a sewer to the MB WWTP within the company, and subsequently discharged into the Hron river.

Harmanec paper mills, Inc., Harmanec

This company produces sanitary paper from wooden matter, scrap paper. As part of the paper production process, waste water is produced. To treat this waste water a second-degree WWTP (WWTP 2°) has been constructed. Once the waste water has been treated by the WWTP 2°, it is discharged through one into the Bystrica stream. Sewage water is treated in a biological treatment plant. Resolution n. 46/72/94 Coll. of 29.6.1994, OÚZP on waste water discharging allows discharg of waste water as long as it maintains, a permitted amount of contamination. Waste water samples are monitored 2-3 times per month to ensure permitted levels of contaminats occur in effluent. In 1998 the company plans to begin the construction of a biological WWTP. This will help to reduce existing acceptable limits of biological contamination of discharged waste water by 50%.

The SNP plant Inc., Ziar nad Hronom

This company is the largest aluminium producer in the Slovak Republic. In 1994 the caking technology of aluminium production was stopped. This resulted in 70% decrease in all types of emissions. In 1996 all of the old style aluminium production technology was decommissioned. In the same year a new technology of electrolytic aluminium production began, called Hydro Aluminia. Water used to cooling is recycled other waste water from the process is discharged to SNP sewer through in the Hron river. The most significant technological waste (red sludge, cinder, ashes) which is generated during the alminium production in different plants, is deposited in settling pits. The settling pit for red sludge disposal had been built with insufficient insulation, which later resulted in the alkaline water seeps into the surrounding areas and ground water and soil contamination. The construction of a sub-terraineous insulating wall around the sludge fields, will prevent infiltration water seeps into the surrounding areas. However, the problem of the settling pit's water regime will have to be addressed. Results acquired from monitoring wells in the SNP plant site and its surroundings have shown that the ground water level can be found 2 to 6 metres under the ground surface, in the altitude of 239 to 243 metres a.s.l. Ground water level and flow

direction is affected by the Hron river. Therefore, general flow direction follows that of the Hron river. In 1997 at the SNP plant Inc. there was a significant drop in industrial water use (compared to the past) in the process of production from 10 151 672 m^3 down to 7 621 163 m^3. The amount of discharged wastewater and the dust of contamination in the effluent discharged to the Hron river has decreased compared to 1996. The plant, has its own local facilities built for waste water treatment, such as NS - 1 (neutralising station) where neutralisation of NaOH and HCl takes place. The discharge from this process is without sediments. The second neutralising station NS - 2 which provides pH treatment and Cr^{6+} reduction, also has waste water discharged without sedimentation. Other facilities are MB WWTP 1, MB WWTP 2, an aperture tank (ŠN - 1) for sewage water from the foundry and adjacent facilities, a sedimentation tank near tailing fields, an industrial water treatment facility, and a ground sedimentation tank no.3 (efficiency of 50-60% for NL). Waste water is discharged into the Hron river through two outlets A + B. Sampling controls of waste water on weekly basis have shown that the acceptable limits for contamination discharge were exceeded at the A outlet. The SNP Plant annually releases financial means for carrying out investment activities in the Environmental measures Program.

Bucina Inc., Zvolen

This is a wood-processing company which produces half-processe wood material and products such as timber, lumber, rafters (raw and impregnated), glued boards, sanded chipboards (DTD), wood facilities, eco-houses, plywood, furniture prisms, and laminated material. Wastewater produced is in the form of sewage water, cooling technological water, which has a high content of organic contamination. Waste sewage water is discharged into the Zolná stream. Cooling and sewage water from different parts of the plant is discharged into the Slatina stream through the main sewer. The problem of post-treatment of industrial and sewage wastewater at a WWTP, remains unsolved, despite the fact that Bucina Inc., has financially assisted in intensification of the Zvolen WWTP. In the process of secondary production during 2° processing the wood using mechanical and chemical processes, hazardous liquid waste is generated. The site where, in the past, liquid waste was deposited, now has a bentonite wall anchored into the impermeable bedrock (neogene). No liquid waste has been deposited on this site since 1994. On the basis of current available technologies, it is planned to draw the liquid phase and to treat it with a gravity-sorption dissociator. Hazardous waste (contaminated sorbents and settled sludge) is eliminated. In 1996 and 1997 the company reconstructed (40 - 50%) of its water network to decrease water consumption from the public water supply, since

there had been high losses incurred through the old network. In 1998 (or in 1999-2000) second phase for improvements to the supply network. The reconstruction of a separate fire water supply will be carried out (currently, industrial and fire water supply is shares a common line where it needs to maintain high pressure, which can cause frequent malfunctions). Permission to discharge wastewater was issued by the ZP Resolution vod. 789/2 403-4/94 - Ša of 30.9.1994 in Zvolen which sets the permissible contaminant limits for different outlets.

Other significant (industrial) pollution sources

Water contamination in the Study Area has been contributed to by other significant producers which are listed as follows:

- Iron works, Inc., Podbrezová
- Central-Slovakia cement works Inc., Banská Bystrica (SCBB)
- SEZ state enterprise Zilina, Zvolen Heating house
- Foundry Inc. Hronec
- Poultry industry Zvolen
- Pohronske machine works Hlnik nad Hronom (discharge to WWTP)
- Plywood Inc., Zarnovica (discharge to WWTP)
- VVO Tekovska Breznica
- Izomat a.s. Nová Bana
- ZIN KOVO Hronský Benadik
- Rolan spol. s.r.o. Nová Bana
- Slovnaft - Benzinol, a.s. Obchodný závod Stozok, Prevádzka Hronský Benadik
- Rolnícke druzstvo Voznica
- Preglejka a.s. Zarnovica
- Sandrik a.s. Hodruša - Hámre

Table 5.1-3 shows discharged wastewater volume and its estimated average concentration of BOD_5 (correspond to the Government Order No.242/1993 Coll. of Laws, see the Supporting Report - Annex E5) produced by the greatest BOD_5 produces of the industrial wastewater effluent sources monitored by SHMU.

3) Mining waste water

At the present, most mining activities have ceased in the Hron basin, and in some places such as Spania Dolina (copper), Kremnica (coins) and Banskas Stiavnica, mining activities was replaced by ore processing cativities. Mining and ore processing activities generate two types of polluted water:

Table 5.1 - 3 List of the Major Industrial Effluents in the Study Area

Distance (km)	Recipient	Total amount of discharged waste water (t/yr) in 1997	Total BOD Load (t/yr) in 1997	Name	Typte of Pollution	Type of Activity	Estimated average concentration of discharged BOD (mg/l)	The Government Order No. 242/1993
183.8	Hron	1172800	189.99	Biotika Slov.Lupca effluent of WW to the Hron	industry	pharmacy	162.0	50.0
9.8	Selčiansky creek-1	1639440	131.16	Harmanecke paper factory Harmanec effluent	industry	paper-industry	80.0	50.0
183.8	Hron	7884000	36.27	Biotika Slov.Lupca effluent of cold waters to the Hron	industry	pharmacy	4.6	50.0
125.3	Hron	725328	32.17	ZSNP Ziar nad Hronom effluent of WW to Hron (B)	industry	smelting	44.4	
3.7	Hodrušský creek	58600	27.15	Bucina Zvolen effluent of WW to Slatina	industry	wood-processing	463.3	50.0
1.1	Sikenica	3154	24.80	Bucina Zvolen effluent of ww to Zolna	industry	wood-processing	7863.0	50.0
203.5	Hron	1395792	20.94	Petrochema Dubova effluent of WW to the Hron	industry	petro-chemical industry	15.0	50.0
0.0	Slatina-1	160243	16.32	Preglejka Zarnovica effluent of WW to Hron	industry	wood-processing	101.8	50.0
2.6	Selčiansky creek-1	173448	14.74	StVaK VK Selce effluent of industrial waste to Selciansky brook (B)			85.0	50.0
73.5	Hron	1522100	11.87	AEMO Nuclear power plant Mochovce effluent of WW	industry	power-plant	7.8	50.0
153.8	Hron	43200	11.23	Bucina Zvolen effluent of WW to Hron	industry	wood-processing	260.0	50.0

Source: Based on the data provided by SHMU (1997) and Povodie Hrona (1999)

Effluents from mines

Because of the lack of recent data on the quality of mining effluents, the Study Team conducted simple in situ and laboratory tests for some samples collected at a few old mining sites including the Spania Dolina and Luietova areas and from drainage tunnel at Banska Stiavnica. Heavy metal concentrations were rather low. It was noticed that pH of these waters showed neutral values rather than acidic. These waters are discharged through tunnels or pipes. Since these tests were not comprehensive, further information is required to evaluate the effect these effluents may have in the Hron river.

Drainage water from mine waste dump sites or tailings

Drainage water from these mine tailings and waste dump sites contributes to the heavy metal content of the surface water and groundwater. Concentrations of pollutants from mine waters at Spania Dolina and Vajskova based on old data (1974 - 1988) and theoretical calculations, have been reported as shown in Table 5.1-4. However, since most of mining activities have ceased and necessary control measures taken for major effluents up to the present, mine and tailing related effluents may not be significant water pollution sources for surface waters in the Hron basin. Further information is necessary to evaluate the currents effect mine waste and dump tailing related effluents have on the Hron river.

Table 5.1 - 4 Concentrations of Pollutants from Mine Water

Name of mine	Concentrations (mg/l)								
	BOD_5	COD	DS	SS	Pb	As	Cu	Zn	Hg
Vajskova	20	80	330	100	0.05	0.1	0.001	0.1	0.01
Spania Dolina	20	110	850	100	0.02	-	0.03	0.07	0.01

5.1.2 STATE OF SURFACE WATER AND POLLUTION LOAD

(1) Evaluation of Surface Water Quality Based on Monitoring Data

Table 5.1-5 and Map 5.1-2 show the water quality classifications of the Hron River based on monitoring data in the two periods: 1989-1990 and 1996-1997 based on water quality categories and their limit values (see the Supporting Report - Annex E.5). The change in the water quality between these periods does not appear to be significant except for a reduction in the concentration of zinc in the upper Hron in the latter period. The state of the water quality of the Hron River according to the Slovak Surface Water Quality classification system during the 1996 - 1997 period is summarised below:

(a) Oxygen regime

- The upper part of the Hron River Basin has a good oxygen regime on the level of class II prevails. Down-grading to class III and IV takes place in the Šálková – estuary of Hron to Kamenin due to industrial and urban sources of pollution.
- From Salkova to Kamenín the class category is lowered by 1 or 2 categories due to the increase of BOD_5 and COD_{cr}.
- The variations in oxygen regime values during the period 1996-1997 were slight.

(b) Basic Chemical and Physical Parameters

- The group of Basic chemical and physical parameters, the classification is mostly influenced by concentration of suspended solids (Determinant SS).
- In the upper part of the Hron River, the concentration of SS is low. At downstream the sampling site in Ziar nad Hronom, concentrations of SS increase (together with Fe and Mn), so as to categorise as class IV or V down to the confluence with the Danube.
- In the middle reaches of the Hron, Sliac the basic chemical and physical parameters indicated into class category V due to high levels of anmonium nitrogen.

(c) Supplementary Chemical Parameters

- The class category changes widely along the river between class I and class V.
- When categorised as IV or V, it is mostly influenced by active chlorine.

(d) Heavy Metals

- At the three sampling sites in the middle reaches of the Hron, Ziar nad Hronom, Zarnovica and Tekovska Breznica, the concentration of zinc increased, the concentration of zinc is relative high, so that it falls into as class IV.
- At Hron-Kamenica the determining parameter is mercury as well as Zinc (class III).

(e) Biological and microbiological parameters

- Except for sampling sites in Kamenin and Kamenica indicated into class category IV, the other sampling sites are categorised into class V.
- Most part of Hron basin are categorised as class V for this category due to the occurrence of coliform bacteria indicating discharges of municipal wastewater with insufficient treatment.

Table5.1 - 5 Water Quality Classes of the Hron River (1989-90 and 1996-97)

No.	Identification of the sampling sites			Water quality classes according to STN 75 7221				
	River	Profile	R.km	A.	B.	C.	D.	E.
H1	Hron	Valkovna	?	II-A2,3	II-B5,10	I	-	V-E2
			261.30	II-A2,4	III-B1	IV-C11	-	V-E3
H2	Hron	Polomka	261.7	II-A2,3	II-B5,10	I	III-D10	V-E2,4
			243.40	II-A2,4	III-B1	I	I	V-E3
H3	Hron	Brezno nad	243.2	II-A2,3	II-B5,10	I	-	V-E2,3
			224.80	II-A2	III-B1	I	-	V-E3
H4	Hron	Valaská	235.3	II-A2,3	III-B8	IV-C9	-	V-E2,3,4,5
			217.00	II-A2,4	III-B1,8,12	IV-C11	II-D10	V-E3
H5	Cierny Hron	Ústie	0.1	II-A2,3	II-B5,10	III-C9	-	V-E2,3,4
			0.05	II-A4	III-B1,8,12	I	-	V-E3
H6	Hron	Nemecká	219.0	II-A2,3	II-B5,8,10	IV-C9	III-D10	V-E2,4
			200.80	II-A2,4	III-B1,8,12	V-C11	II-D10	V-E3
H7	Hron	Šalková	199.0	III-A2	III-B5,8	IV-C9	-	V-E2,3,4,5
			181.40	III-A2,4	III-B1,8,12	II-C10	-	V-E3
H8	Hron	Banská Bystrica	192.2	III-A2	III-B8	IV-C9	-	V-E2,3,4,5
			175.80	III-A2,4	III-B1,8,12	IV-C11	-	V-E3
H9	Bystrica	Banská Bystrica	2.3	III-A2	III-B8	II-C3,4,8	IV-D1,10	V-E2,3,4,5
			2.10	II-A2,4	III-B1	II-C4	II-D1,5,10	V-E3
	Malacho vský p.	Ústiec	0.0	II-A2,3	III-B8	I	IV-D1,10	V-E2,3,4,5
H10	Hron	Sliac	177.0	III-A2,3	III-B5,8,12	V-C9	IV-D10	V-E2,3,4,5
			161.10	III-A2,4	V-B11	IV-C11	II-D10	V-E3
H11	Hron	Zvolen MB COV	168.1	III-A2,3	III-B5,8	I	-	V-E2,3,4,5
			153.60	III-A2,4	III-B1,5,8,12	IV-C11	-	V-E3
	Slatina	Nádrz Hrinová	48.0	II-A2,3	IV-B1	I	I	III-E2,5
	Slatina	Pstruša	21.5	III-A3	III-B8,10	IV-C9	III-D3,10	V-E2,3,4
H12	Hucava	Hrochoy	23.0	II-A2,3	III-B5	I	-	V-E2
			13.80	II-A2	III-B1,8	I	-	IV-E3
H13	Zolná	Ústie	0.2	III-A2,3	III-B5,8,10	V-C9	-	V-E2,3,4,5
			0.50	II-A4	III-B1,5,8,12	V-C11	-	V-E3
H14	Neresnic a	Ústie						
			0.50	II-A2,4	III-B1,5,8,12	III-C11	-	V-E3
H15	Slatina	Ústie	0.1	III-A2,3	III-B8,10	V-C9	IV-D10	V-E2,4
			0.30	II-A2,4	III-B1,8,12	V-C11	II-D10	V-E3
H16	Hron	Budca	162.8	III-A2,3	III-B5,8	V-C9	-	V-E2,3,4,5
			148.20	IV-A4	IV-B5	I	-	V-E3
	Kremnic ký p.	Kremnica pod	12.6	III-A2,3	IV-B8	III-C10	IV-D5,10	V-E2,3,4,5
	Kremnic ký p.	Ústie	0.6	III-A2,3	III-B8	III-C10	IV-D10	V-E2,5
H17	Hron	Ziar nad Hronom	146.1	III-A2	III-B5,8	I	IV-D10	V-E2,3,4,5
			131.50	IV-A4	V-B5	II-C10	IV-D10	V-E3
H18	Hron	Zarnovica	126.1	III-A2	III-B5,7,8	II-C8	IV-D10	V-E2,3,4,5
			112.00	IV-A4	V-B5	II-C10	IV-D10	V-E3
H19	Hron	Tekovská Brez.	103.0	II-A2,3	IV-B5	I	III-D2,10	V-E2,4,5
			88.90	IV-A4	V-B5	I	IV-D10	V-E3
	Hron	Tlmace	89.6	II-A2,3	IV-B5	V-C9	-	V-E2,4,5
H20	Hron	Kálna n. Hronom	76.5	II-A2,3	IV-B5	IV-C9	-	V-E2
			63.70	III-A2,4	V-B5	IV-C11	-	V-E3
H21	Sikenica	Ústie	2.7	III-A2	IV-B5	II-C2	-	V-E2,5
			2.70	IV-A4	V-B5	I	-	IV-E3
H22	Hron	Kamenín	15.0	III-A2	IV-B1,2,5	I	-	V-E2
			10.90	III-A4	IV-B11	I	-	V-E3
H23	Hron	Kamenica						
			1.70	II-A2,3,4	III-B1,7,8,12	III-C9	III-D1,10	IV-E3

Note: Upper: Classification based on the data during 1989 – 1990, Lower: Classification based on the data during 1996 – 1997, Indices (such as A2, B1, etc.) following the class category (II, III, IV and V) in columns 5 through 9 indicate parameters shown in the Supporting Report E.5 that determined the class category.

Source: Extracted from the latest data by SHMU

(2) Long-term Trend of Major Water Quality Parameters

On the basis of surface water monitoring data between 1980 and 1997 from SHMU, long-term trends in changes of major water quality parameters have been analysed as shown in the Supporting Report - Annex E.3. The parameters include the following:

- BOD_5 as an indicator of organic pollutants
- Nitrogen and phosphorus as indicators of fertiliser-derived nutrient salts
- Heavy metals as indicators of toxic substances
- Coliform bacteria as an indicator of pollution of human and animal origins

1) BOD_5

BOD_5 concentrations have generally decreased in the 1990's compared to the 1980's.

2) Nitrogen and Phosphorus

The concentration of ammonium nitrogen generally shows a slight decrease from the 1980's to the 1990's, with relatively high values observed at sampling points around Zvolen. The concentration of nitrate nitrogen, though it varies widely, shows a trend similar to ammonium nitrogen. High concentrations of total phosphorus observed in the first half of the 1980's dramatically decreased during 1985 - 1986, and its level has been maintained to the present.

3) Heavy Metals

General trends for the concentrations of mercury, cadmium, lead, and copper are to decrease little by little from the 1980's to the 1990's. The points exhibiting high values in the 1980's were located in Banska Bystrica and Zvolen. The concentrations of zinc have decreased since 1990 in the areas between Banska Bystrica and Ziar nad Hronom.

4) Coliform Bacteria

Concentration of coliform bacteria has shown no significant change between the 1980's and the 1990's. As shown Map 5.1-3, high values are observed in and around Banska Bystrica in 1995-1996. At Hron/Budca data collected in the 1990's even show an increase from the level seen in the 1980's. The long term trends of fecal coliform bacteria which has only been limited in recent years is hard to interprete due to the short period for the data availability.

(3) Pollution Load and River Quality

Table 5.1-6 and Figure 5.1-3 shows discharged loads of BOD_5, and their concentrations in the Hron River water along the main reach of the Hron in 1996-1997. The concentration of BOD_5 exceeded the set of acceptable limit by the Government Order No. 242/1993 Coll. of Laws (see the Supporting Report - Annex E.3) in the areas between Banska Bystrica and Zvolen due to the particular high pollution load (large numbers of effluent sources) in this area.

The analysis of the BOD_5 load in 1997 of waste water effluent sources based on SHMU data are shown in Table 5.1-7, Map 5.1-4. The BOD_5 load of municipal waste water effluents accounts for 70.1% of the recorded BOD_5 load discharged in the Study Area. Among the municipal wastewater effluents, the BOD_5 load of VK (Wastewaetr Treatment Plant, WTP) Banská Bystrica is the largest, at 38.1% of the total, followed by VK Levice at 14.3%. The top 10 wastewater effluents is seen in Table 5.1-7b. Levels of wastewater treatment are mostly inadequate to meet the Government Order No.242/1993 Coll. of Laws, which sets acceptable limits of pollutant concentration for the discharges.

Industrial waste water effluents account for 28% of the total BOD_5 load discharged. These sources are mostly located in the area between Banska Bystica and Zvolen. The largest source of BOD_5 load among industries is BIOTIKA Slov. Lupca (10.5% of the total), followed by HP Harmanec (6.1%), Bucina Zvolen (3.4%) and ZNSP Ziar nad Hronom (2.0%). Most of these effluents exceed the acceptable limit of BOD_5 concentration provided in the Government Order No. 242/1993 Coll. of Laws.

Table 5.1 – 6 BOD Concentration (1995-1996) and Load (1996-1997) Along the Hron Main Reach

NEC	Location	Distance (km)	BOD5 (*2) 1995 - 96 (mg/l)	BOD load of wastewater effluents monitored by SHMU (t/yr)		Number of monitored wastewater effluents		Number of the effluents not meeting the regulation (*1)	
				1996	1997	1996	1997	1996	1997
		284.0							
R008000D	Valkovna	261.3	2.73						
R014000D	Polomka	243.4	2.95	2.95	3.54	2	2	0	0
R025010D	Brezno nad	224.8	3.50	1.44	1.43	1	1	0	0
R028000D	Valaska	217.0	4.65	83.89	55.86	4	5	2	3
R048000D	Nemecka	200.8	4.03	106.69	87.84	14	16	3	2
R064000D	Salkova	181.4	8.30	267.41	250.19	10	10	2	1
R095010D	Banska Bystrica	175.8	8.71	4.73	3.55	1	1	0	0
R112000D	Sliac	161.1	8.20	**1270.39**	**990.15**	**22**	**23**	**4**	7
R113000D	Zvolen MB CO	153.6	7.76	35.35	39.84	12	13	1	1
R156000D	Budca	148.2	9.99	268.31	165.50	9	9	5	4
R185000D	Ziar nad Hrono	131.5	5.43	70.27	44.33	9	9	3	4
R223010D	Zarnovica	112.0	5.05	87.22	70.39	8	8	2	0
R234000D	Tekovska Brez.	88.9	4.60	16.02	22.06	3	5	1	1
R247000D	Kalna n. Hrono	63.7	4.35	34.89	32.96	2	3	0	0
R340000D	Kamenin	10.9	4.38	389.82	368.23	10	10	2	2
Duna	Kamenica	0.0							
				2640.50	**2136.69**	**108**	**116**	**25**	**25**

Source: Based on the data provided by SHMU

Note: (*1) The Government Order No.242/1993

(*2) This Order also be requires that the BOD concentration be achieved less than 4mg/l in all rivers by 2005.

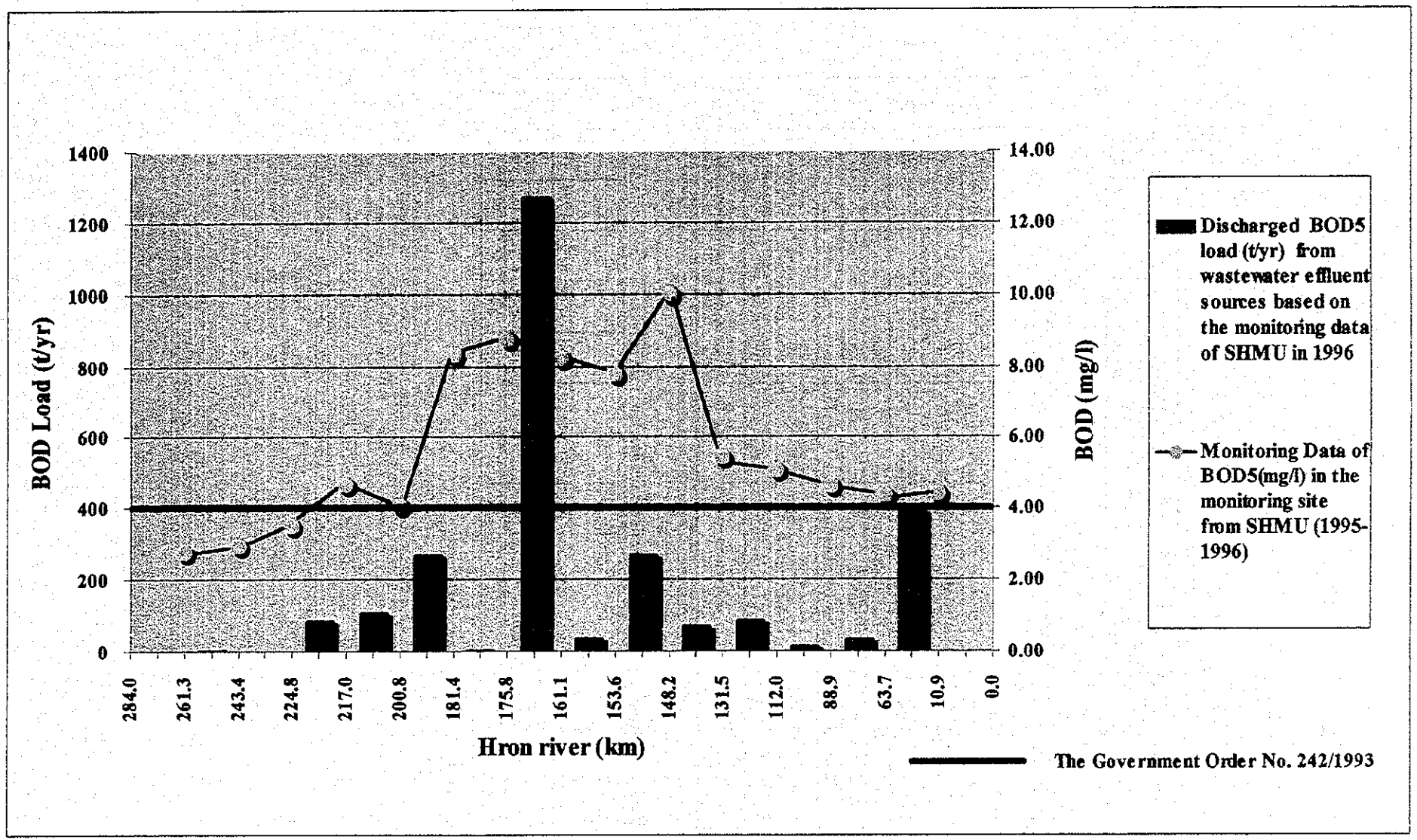


Figure 5.1 - 3 BOD Concentration (1995 – 1996) and Load (1996 – 1997) Along the Hron Main Reach

Source: Based on the digital data provided by SHMU

Table 5.1 - 7 BOD Load of Wastewater Effluents in the Study Area

a. Classification of wastewater effluent sources in the Study Area in 1997

Category		BOD (t/yr)	%
1	Industrial waste water effluents (treated or untreated)	606	28.0
2	Public sewerage systems managed by waterworks	1516	70.1
3	Other wastewater discharges in municipalities	28	1.3
4	Agricultural farm(animal) and municipal sewage treatment	14	0.6
	total	2163	100.0

b. BOD Load of major wastewater effluents in the Study Area in 1997

Category	Locatin No. in Figure 5.1-6	Name - Locality	River(km)	Recipient	BOD (t/yr)	%
1	3	BIOTIKA Slov. Lupča	183.8	Hron	226	10.5
1	4	HP Harmanec	9.8	Selčiansky creek-1	131	6.1
1	8	Z SNP Žiar nad Hronom	125.3	Hron	43	2.0
1	7	Bučina Zvolen	1	Sikenica	74	3.4
2	1	VK Brezno	222.3	Hron	56	2.6
2	5	VK Ban. Bystrica	181	Hron	825	38.1
2	6	VK Zvolen	152	Hron	109	5.1
2	8	VK Kremnica	15	Kremnický creek-1	41	1.9
2	10	VK Levice	2.2	Podlužianka	310	14.3
1,2,3,4				others	348	16.1
				total	2163	100.0

c. Change in BOD Load of major wastewater effluents for the past ten years

Category	Locatin No. in Figure 5.1-6	Name - Locality	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	3	BIOTIKA Slov. Lupča	1038	684	242	287	275	221	273	240	239	226
2	5	VK Ban. Bystrica	3865	2981	3045	2894	2926	2879	2493	1603	1129	825
2	10	VK Levice	1145	890	-	-	594	647	378	432	349	310

(t/yr)

Source: Based on the data provided by SHMU

Although the above mentioned sources are major polluters among those being monitored, untreated domestic sewerage discharges from areas that are not currently being monitored are also an important cause of surface water pollution. BOD_5 loads of effluents from areas not connected to the sewerage system were estimated based on the data from each Okres concerning the state of sewerage connection (see Table 5.1-8). This was calculated based on an estimate of BOD_5 production of 18.25 kg/person/year for people without connection to the sewerage system (Water Research Institute estimate Ref 9-8). The Okres with the sewer connection rate lower than the national average (53.03%) and discharging high BOD_5 loads include: Levice (53% of population not connected to sewer, estimated 958 t/yr of the BOD_5 produced from those not connected to sewer), and Brezno (63.9%, 764 t/yr). Okres with a sewer connection rate higher than the national average, but still having a high BOD_5 load from areas not connected to sewer are: Banska Bystrica (only 22.6% not connected producing an estimated 466 t/yr BOD_5 load), Zvolen (33.5% not connected, producing 442 t/yr), and Ziar nad Hronom (42.7% not connected, producing 431 t/yr).

Table 5.1 - 8 The state of public sewer connection and Estimated production of BOD_5 road without public sewer in the Study Area

KRAJ	OKRES	Population	Population connected to public sewer	The public sewer connection rate	Estimated BOD_5 load of the population connected to public sewer (t/yr) (*)		Estimated BOD_5 load of the population unconnected to public sewer (t/yr)
		1996	1996	1996	1996	1997	1996
Banska Bystrica	BB	112926	87381	77.4	1163	862	466
	BS	14419	9758	67.7	60	60	85
	BR	65483	23615	36.1	137	97	764
	DT	32541	14495	44.5	63	63	329
	RA	N/A	N/A	N/A	N/A	N/A	N/A
	ZC	27780	10946	39.4	44	49	307
	ZH	55239	31643	57.3	119	86	431
	ZV	72263	48026	66.5	129	129	442
Nitra	LV	98952	46475	47.0	406	361	958
	NZ	40109	10150	25.3	74	74	547
	ZM	21721	N/A	N/A	N/A	N/A	N/A

(*): Based on the data of SHMU for wastewater effluents

As mentioned above, it can be concluded that the major sources of pollution in the study area are treated or untreated effluents from public sewerage systems and industries. Furthermore, it is noted that only a few sources, such as the sewerage systems of Banska Bystrica, Levice, and waste water from BIOTIKA comprise a large part of the total organic pollution load. However, the load from these sources had decreased from during the period from 1985 to 1997.

5.1.3 SURFACE WATER MANAGEMENT – LEGAL AND INSTITUTIONAL SYSTEM

(1) Institutional System of Surface Water Management

There are many organisations related to management of water in the Study area (see Figure 5.1-4). For evaluation and analysis of water quality and its pollution sources in the Hron River Basin, it is necessary to obtain relevant information from the following organisations:

- Slovak Hydrometeorological Institute (SHMU)
- Slovak Water Management Authority – River Hron Watershed (PH: Povodie Hrona)
- Central Slovak Water Supply and Sewerage Company (StVak)
- Western Slovak Water Supply and Sewerage Company (ZsVak)
- Slovak Water Research Institute (VUVH)

SHMU performs the central role in the monitoring of surface water quality in the Slovak Republic. Since other organisations are also involved in monitoring activities relevant to their duties, SHMU collects data from them including the data on wastewater effluents.

Therefore SHMU has been the sources of most of the Study Team's data on surface water and wastewater. However, the latest data concerning actual and future capacities and treatment efficiencies of waste water treatment plants are not readily available because relevant authorities such as StVak and ZsVak have not been able to supply sufficient data.

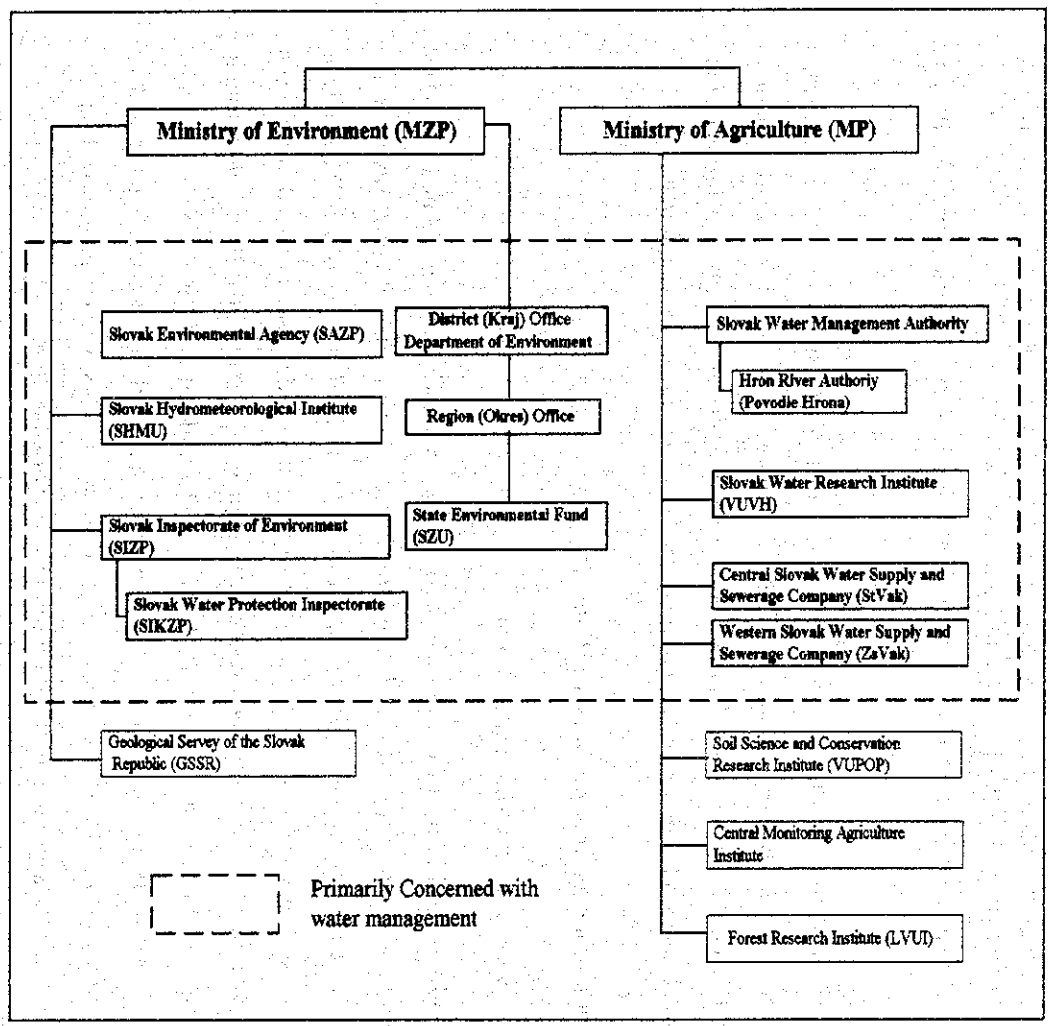


Figure 5.1 - 4 Organisations Relevant to Water Management of the Hron River Basin

Prepared by JICA Study Team

(2) Necessity of Compatibility with Relevant Plans

The following latest plans present comprehensive information on the state, issues and recommendations regarding surface water in the Study Area. The content of the REMP related to surface water should be compatible with these plans which are under the responsibility of the Slovak Ministry of Environment and Ministry of Agriculture.

- Hydro-ecological plans of Hron River for the period 1996-2000, by Ministry of Environment and Water Research Institute
- Water management plan in Hron river in 1995, by Ministry of Agriculture and Povodie Hrona

Furthermore as shown in Figure 5.1-5, there are other programmes related to the water environment in the Study Area. Therefore it is most important for the efficient preparation of the REMP to identify the necessary data including priority issues and recommendations that are common to all these relevant plans / programmes, and to integrate them into the REMP.

(3) Monitoring System for Surface Water Quality

1) Overview of monitoring system for surface water

The role and responsibilities of each organization in the monitoring system related to surface water quality and waste water effluent in the Study Area , though it is not clear. However, the Study team have attempt to summarise the monitoring system in Figure 5.1-6. SHMU collects water quality data themselves and from other organisations that are involved in relevant monitoring activities, including data on wastewater effluents. Despite SHMU's central role in the monitoring of surface water quality in the Slovak Republic, it is difficult to obtain further information, such as pollution sources. For evaluation and analysis of water quality and its pollution sources in the Hron River Basin, it is necessary to obtain relevant information, not only data, but also back-ground information from various organisations.

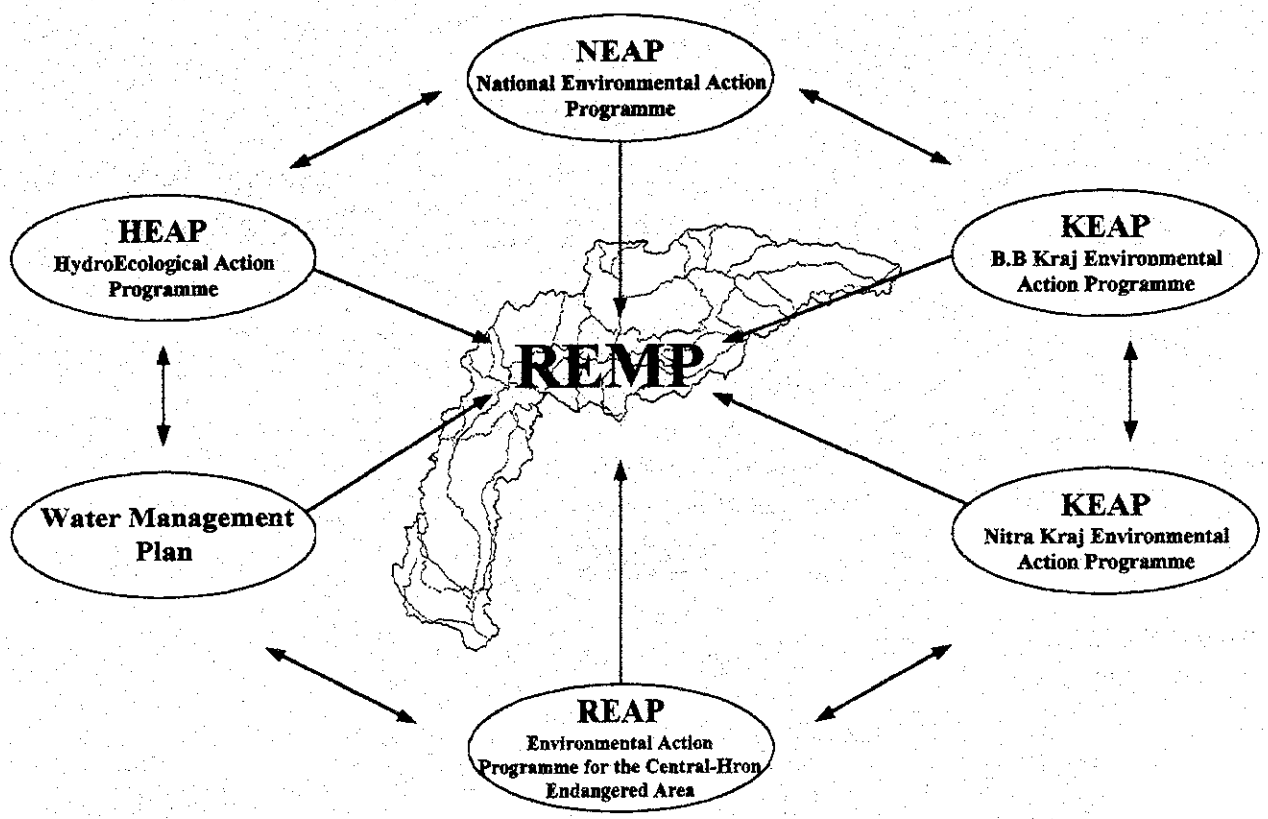


Figure 5.1 - 5 Environmental Plan / Programmes Relevant to the REMP for the Study Area

Prepared by JICA Study Team

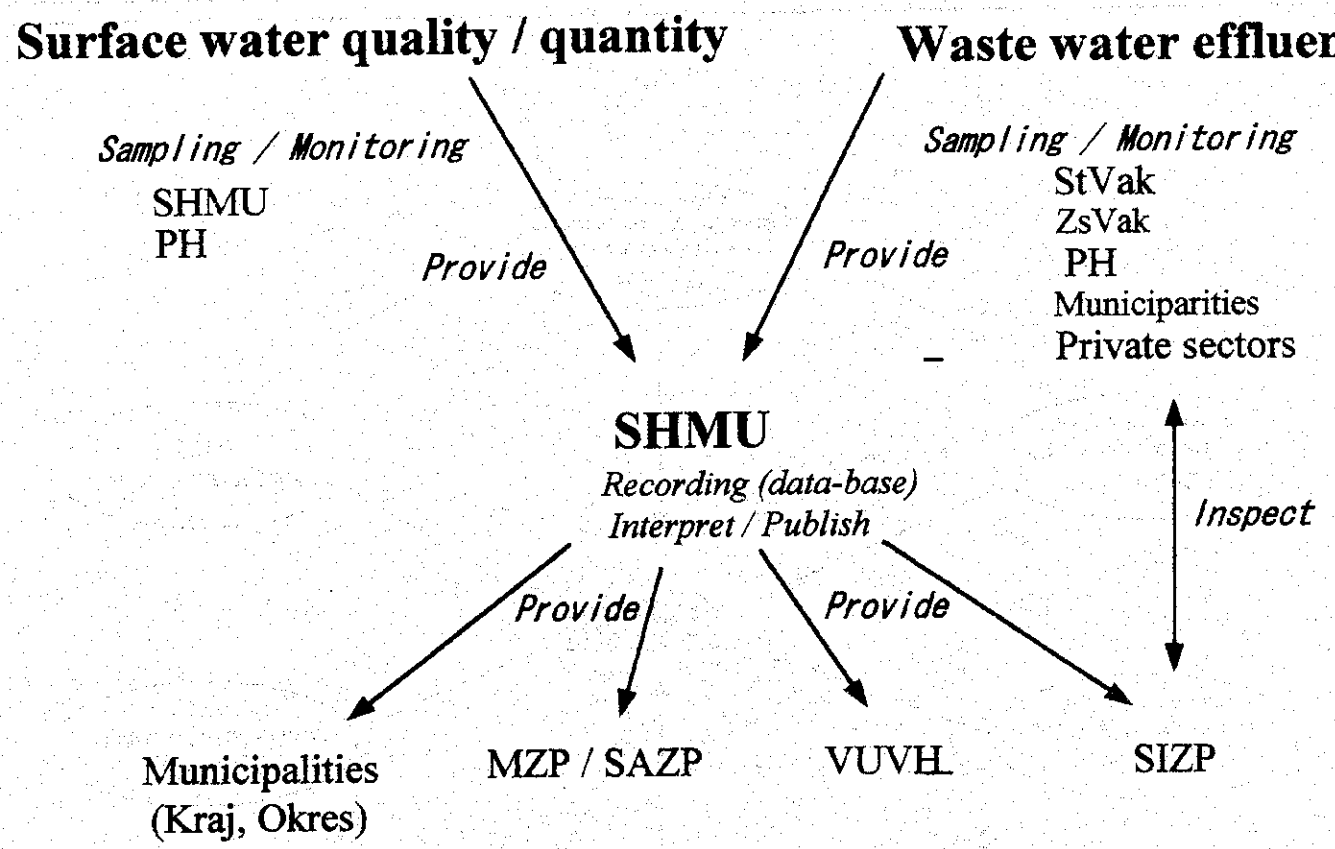


Figure 5.1 - 6 State of monitoring system on surface water in the Study Area Prepared by JICA Study Team

2) Monitoring system for surface water quality

The sampling sites of SHMU in the Hron River basin for surface water quality monitoring are shown in Map 5.1-5 and the Supporting Report - Annex E.5. The number of sampling sites decreased from 27 in 1991 to 23 in 1997. Monthly data on surface water quality are stored in the database system "MAGIC," Department of Water Quality, SHMU.

(4) Method of Evaluation and Classification of Water Quality

The evaluation of surface water quality in Slovakia is made according to the methods provided by the State Standards STN 75 7221. Quality of surface water is classified into 5 categories and the classification of water quality is made in each of 6 groups of parameters shown as shown in the Supporting Report - Annex E.5. Further, the classification of water quality is made in each of 6 groups of parameters shown in the Supporting Report-Annex E.5.

The classification of water in each group is made based on the measured parameter values with a 90% probability of non-exceedence of the limit value specified for each parameter as shown in the Supporting Report - Annex E.5. For the classification, the monitoring data must cover a continuous period of at least one year with minimum 24 samples. When the monitoring frequency is 12 times per year, two years data are required for the classification.

(5) Legal System of Pollution Elimination for Surface Water

According to the regulation of the Government of the Slovakia Republic, " the Government Order No. 242/1993 Coll. of Laws " has been enforced from 12th October 1993* (See the Supporting Report - Annex E.5). The Slovak Republic has been preparing new regulation to set adjust for E.U criteria by 2005.

* This sets up indicators for permissible water pollution levels.

(6) Conclusion

To sum up above sections, followings can be concluded while the information is quite limited on this matter and the state of environmental issues are still under the drastic change at the present.

a) SHMU collects water quality data themselves and from other organisation that are involved in relevant monitoring activities, including data on wastewater effluents. Despite SHMU's central role in the monitoring of surface water quality in the Slovak

Republic, it is difficult to obtain further information, such as pollution sources. For evaluation and analysis of water quality and its pollution sources in the Hron River Basin, it is necessary to obtain relevant information, not only data, but also back-ground information from various organisations.

b) Since there are many plans/programmes related to the water environment in the Study Area, some parts of those programmes are overlapping with each other. Furthermore, it takes much time and effort to obtain up-to-date data from various organisation and it can be difficult to identify sources of data for practical water quality management.

c) Due to the lack of budget, the number of sampling sites of SHMU in the Hron River Basin for surface water quality monitoring decreased from 27 in 1991, to 23 in 1997. In addition, only a limited number of parameters (including some toxic substances) are monitored.

5.1.4 MAIN SURFACE WATER ISSUES AND RECOMMENDATIONS

(1) Summary of Existing State and Issues

The state of surface water quality and pollution sources in the Study Area can be summarized as follows.

1) Water quality

a) Despite the fact that the Hron River has a considerable capacity of self-purification, its water quality is generally assessed to be polluted. The pollution is demonstrated particularly by the high values of microbiological pollution parameters such as coliform bacteria, and to a lesser extent by other organic and chemical/physical parameters included heavy metals. Based on water quality data from 1996 - 1997, the river water is not suitable for any purpose without treatment or only suitable for limited purposes.

b) BOD_5, which is the most important indicator of organic pollution, occurs at high concentrations, in excess of the permissible concentration of the Government Order No. 242/1993 Coll. of Laws, between the Banska Bystrica area and the Zvolen area, due to industrial and urban sources of pollution. High BOD_5 concentrations still occur here despite a relatively good prevailing oxygen regime in the upper and lower part of the Hron River.

c) Heavy metal concentrations are, in general, at acceptable levels in the Hron River Basin, except around the Zarnovica area, where the concentration of zinc is relatively high, so as to fall into category IV of the Slovak Classification of Surface Water Quality (STN 75 7221).

2) Major Water Pollution Sources – Domestic and Industrial

a) Deficiency of wastewater treatment plants and inadequate treatment of domestic and industrial wastewaters in existing plants are considered to be the major causes of the

pollution of the Hron River water. There are 126 (1997) identified effluent sources which discharge to the Hron River system related to municipal, industrial, and a few agricultural sources.

b) The organic pollutant loads are comparatively high between the Banska Bystrica area and the Zvolen area where many of the major sources of pollution are concentrated. According to the BOD_5 load data (t/yr) for the 126 identified effluent sources in 1997, the main pollution sources are municipal wastewater and industrial wastewater.

c) The BOD_5 load of municipal waste water effluents accounts for **70.1%** of the recorded BOD_5 load discharged in the Study Area. Among the municipal wastewater effluents, the BOD_5 load of VK (Wastewater Treatment Plant) Banska Bystrica is the largest, at 38.1% of the total, followed by VK Levice at 14.3%. Levels of wastewater treatment are mostly inadequate to meet the Government Order No.242/1993 Coll. of Laws, which sets acceptable limits of pollutant concentration for the discharges.

d) Industrial wastewater effluents account for **28%** of the total BOD_5 load discharged. These sources are mostly located between the Banska Bystrica area and the Zvolen area. The largest pollution producer as for BOD_5 indicator among industries is BIOTIKA Slov. Lupca (10.5% of the total) followed by HP Harmanec (6.1%), Bucina Zvolen (3.4%) and ZNSP Ziar nad Hronom (2.0%). Most of these effluents exceeded the acceptable limit of BOD_5 concentration provided in the Government Order No. 242/1993 Coll. of Laws.

e) Although the above mentioned sources are major polluters among those being monitored, untreated domestic sewage discharges from areas that are not currently being monitored are also an important cause of the surface water pollution. BOD_5 loads of effluents from areas not connected to the sewerage system were estimated based on the data from each Okres concerning the state of sewerage connection. This was calculated based on an estimate of BOD_5 production of 18.25 kg/person/year for people without connection to the sewerage system (Water Research Institute estimate Ref 9-8). The Okres with a sewer connection rate lower than the national average (53.03%) and discharging high BOD_5 loads include: Levice (53% of population not connected to sewer, estimated 958 t/yr of the BOD_5 produced from those not connected to sewer), and Brezno (63.9%, 764 t/yr). Okres with a sewer connection rate higher than the national average, but still having a high BOD_5 load from areas not connected to sewer are: Banska Bystrica (only 22.6% not connected producing an estimated 466 t/yr BOD_5 load), Zvolen (33.5% not connected, producing 442 t/yr), and Ziar nad Hronom (42.7% not connected, producing 431 t/yr).

3) Water Quality Management – Institutional and Legal Issues

a) Despite SHMU's central role in the monitoring of surface water quality in the Slovak Republic, it is difficult to obtain further information, such as pollution sources. For evaluation and analysis of water quality and the pollution sources in the Hron River Basin, it is necessary to obtain relevant information, not only data, but also background information from various organisations e.g. SVP, SIZP, Okres office and industries themselves. As a result, an appropriate data/information management system might be

necessary to promote interactions between the many organizations involved in water quality management of the Hron River Basin.

b) Since there are many plans/programmes related to the water environment in the Study Area, some parts of those programmes overlap with each other. Furthermore, it takes much time and effort to obtain up-to-date data from various organisations and it can be difficult to identify sources of data for practical water quality management. Therefore it is most important for efficient water quality management to set up the above mentioned system.

c) There is a lack of specific Water Quality Objectives for the Hron River. The Government Order No. 242/1993 Coll. of Laws set some 'permissible levels' for 'water management river' and 'other surface water', however his could be made more specific defining water quality objectives depending on how a particular stretch of water is to be used. For example different Water Quality Objectives could be set for canoeing, sailing and other contact recreation activities; fishing; industry (eg cooling water); irrigation.

d) Due to a lack of budget, the number of SHMU surface water monitoring sampling sites in the Hron River Basin decreased from 27 in 1991, to 23 in 1997. In addition, only a limited number of parameters are monitored. It is necessary to share data, relevant to water quality management, collected by each organisation working within the Hron River Basin eg sharing of surface water data collected by StVak, PH, SHMU and SIZP.

(2) Recommendations

For the improvement of the water quality in the Study Area, the following are recommended:

Water Quality Objectives

A programme should be set up to develop water quality objectives according to expected uses. For example, a certain stretch of the river may be proposed for recreational use. If this stretch of the river currently has a surface water quality of V, E3 (Coliform bacteria) and also falls into class V for nitrite, it is the coliform bacteria that are likely to cause the most harm to the user of this stretch of river. Therefore, it is most important for the water quality objectives to be focussed on prioritisation of the reduction of the amount of coliform bacteria present in this stretch of the river before it can be used for this purpose.

The programme to set water quality objectives should involve cooperation between a number of the organisations involved in the Hron River Basin including: PH, SHMU, StVak, ZsVak, NGOs (e.g. fishermen, watersports) SAZP, SIZP. Any EU Directives on water quality objectives should be taken into consideration.

Domestic Wastewater Collection and Treatment

a) The surface water pollution by coliform bacteria, caused by the deficiency of municipal sewerage in the Study Area, is the most significant environmental issue for the long term. To improve the surface water quality, the up-grading of sewerage system with sufficient coverage of urbanized area along the Hron River, particularly those areas between Banska Bystrica and Zvolen and at Levice is recommended. This should be coupled with the expansion of sewage treatment plants and improvements in their operation.

i) To ensure connection of all sewerage collectors to Waste Water Treatment Plants. Banska Bystrica and Levice already have approval from the Slovak Republic Government for this work.

ii) Carry out the expansion of existing wastewater treatment plants, particularly at Banska Bystrica and Levice.

iii) Continued development of sewerage systems in villages, towns and municipalities so that by 2005, 57% of inhabitants live in houses that are connected to the public sewerage system. (Ref. 5-4).

b) A series of feasibility studies are recommended for those sub-catchments in rural areas where municipal sewerage systems are deemed to be a priority. These studies should seriously consider linking the sewerage systems of adjoining villages. Consideration should also be given to the use of reed-beds (as a supporting method of biological methods) as a low cost means of treating rural / municipal wastewater.

c) To realize the development of a sewerage system in towns and municipalities, priority projects should be identified using appropriate methods such as decision making system. A theoretical example of a decision making system to prioritize sewerage system improvement is included in the supporting report Annex N. This prioritises sewerage system improvements based on both technical and socio-economic factors.

Industrial Wastewater Treatment

d) Improvement of industrial wastewater treatment at each industrial plant, particularly for the removal of heavy metals, organics and other hazardous substances is recommended. When discharged directly to surface water, pollutants should be reduced so as to comply with the Government Order No.242/1993 Coll. of Laws and by 2005 with the EU Directive 91/271/EEC.

i) Risk assessment of industrial effluent prior to release could be used to determine ways of minimising the risk of adverse impacts to the River system from industrial effluent. Monitoring of effluent quality by the industries themselves to ensure compliance with standards should occur (Government Order 242/1993 Coll. of Laws up to the end of 2004 and EU Directive 91/227/EEC from 2005).

ii) Reduction of pollutants discharged from Biotika Slovenska Lupca, particularly the content of the ammonium ions through implementation of the project 'Ecologising Biotika' (document produced by Biotika). This involves the restructuring of Biotika's anaerobic WWTP and the repair of its sewer network.

iii) In Bucina, Zvolen, treatment of wastewater discharged into the Slatina should ensure compliance with above mentioned Slovak Order and EU Directive.

Institutional and Legal

e) Since the main costs for construction and operation of municipal sewerage systems must be borne by each municipality, a small municipality alone cannot meet such a requirement. Therefore, development of a practical institutional system is considered to be necessary, so that a sewerage system covering, for example, a few or several municipalities in a sub-basin of the Hron can be constructed and operated through the co-operation of those municipalities.

f) The legal framework governing larger industrial plant's effluent discharges could be changed to ensure that these larger factories have to comply with the EU's IPPC (Integrated Pollution Prevention and Control) Directive 96/61/EC.

g) Since IPPC only covers the larger industries, medium and small industries could establish Environmental Management Systems, certified under ISO 14001 for 50% of industries by 2005.

h) A River Basin Management Board could be set up as a co-ordinating body in order to ensure and promote interactions and data sharing between the many institutions involved in the water quality management of the Hron River Basin. This board could also meet to discuss and agree priority actions and investment programmes. This board could include representatives from: PH, StVak, ZsVak, SHMU, SIZP, State Health Institute, SAZP, Mesto, Kraj / Okres, NGOs and Industry Representatives. This would fit in well with the EU Framework Directive Water which wishes to ensure 'the establishment of appropriate administrative arrangements, including the identification of the appropriate Competent Authority'

Existing proposals and recommendations relating to surface water quality such as the Hydro-Ecological Plan (Povodie Hrona), National Environmental Action Program (Ministry of Environment) and Regional Environmental Action Program (Slovak Environmental Agency) should be consulted alongside these recommendations.

Table 5.1-9 summarises objectives, targets, recommended measures, and key agencies in order to work toward attaining **the Goal of improving surface water quality in the Hron River Basin. All surface water for the Hron should be aiming to attain class III of the Slovak Water Quality Classification System (STN 75 7221), by 2010.**

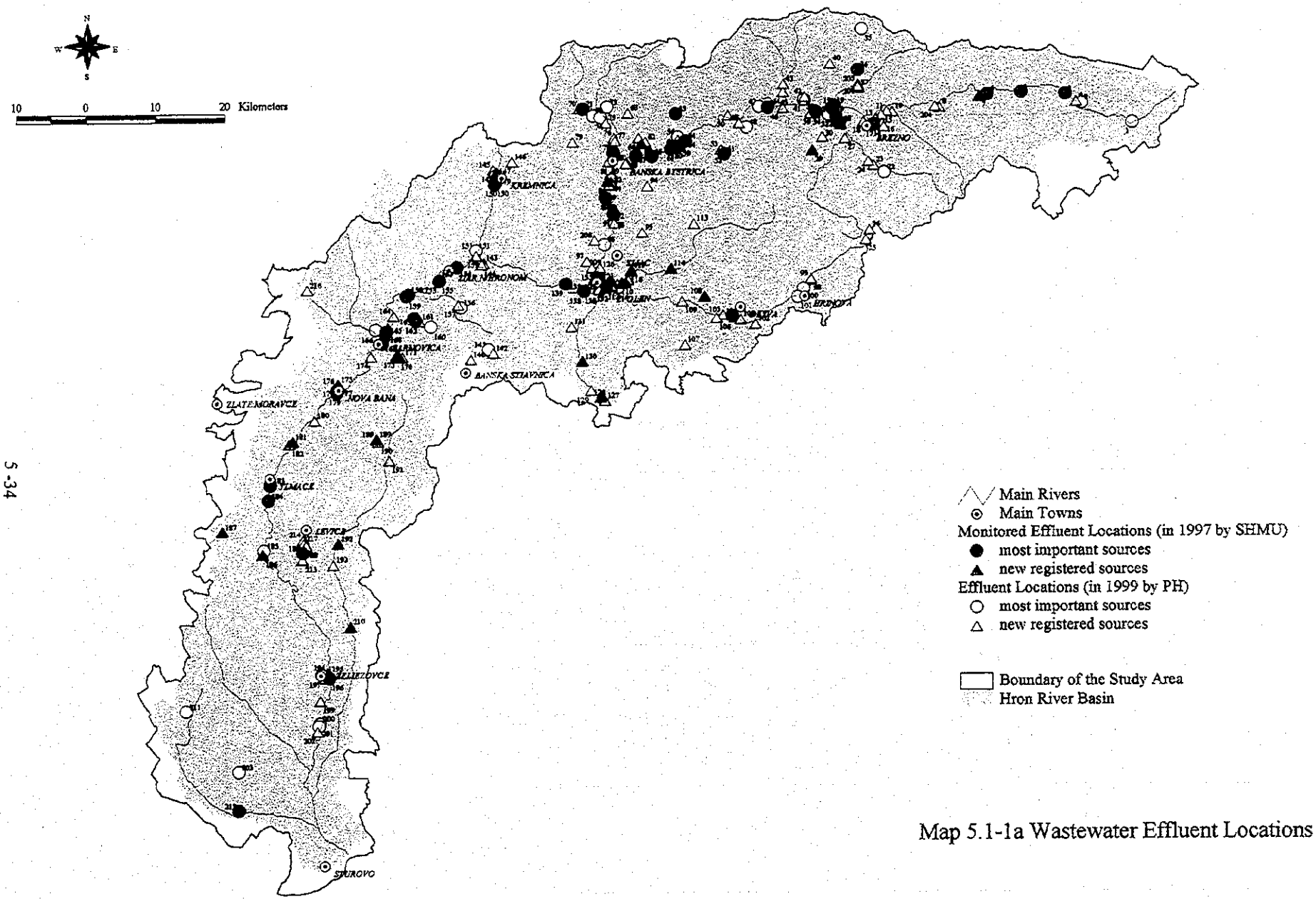
Table 5.1 - 9 Summary Table of Actions to Improve Surface Water Quality

Issue	Objective	Target	Recommended measures	Key Agency
SW1) Lack of concrete strategic objectives of water quality comparatib le with EU directives	Development of water quality objectives to guide the management of the river	By 2001. In conceptual materials EU Directives on water quality objectives should be taken into consideration.	(SW1.1) Cooperative programme to develop water quality strategic objectives according to expected uses.	SHMU, PH, MZP, StVak, ZsVak, NGOs (e.g. Slovakia Peasant Union, fishermen, watersports) SAZP, SIZP, MVO, MP
SW2) Domestic waste water treatment	Up-grade of sewerage systems coupled with the expansion of sewerage treatment plants and improvements in their operation to reduce BOD_5 input into Hron	By 2005, 57% of inhabitants to be connected to efficiently working sewerage treatment system.	(SW2.1) The expansion of existing wastewater treatment plants and connection of all sewerage collectors to the Waste water treatment plants at Banska Bystrica, Zvolen, Kremenica, Ziar nad Hronom and Levice.	StVak, ZsVak, MP, VUVH, Municipalities, MZP, SFZP.
		The end of 2000.	(SW2.2) Development and application of a decision making system for prioritising domestic sewerage system improvements	StVak, ZsVak, MP, VUVH, municipalities, MZP
		Produce 3 feasibility studies for domestic sewerage systems of different types in priority areas per year after the development and application of decision making system.	(SW2.3) A series of feasibility studies for rural areas where domestic sewerage systems are deemed to be a priority. These studies should seriously consider linking the sewerage systems of adjoining villages. Consideration should also be given to the use of reed-beds (and other biological methods) as a low cost means of treating rural/municipal wastewater.	StVak, ZsVak, MP, VUVH, municipalities, MZP
		Detailed design within one year of feasibility study; construction within three years.	(SW2.4) The detailed design and construction of Waste Water Treatment facilities and connections in priority areas identified by decision making system and feasibility studies.	StVak, ZsVak, MP, VUVH, municipalities, MZP
SW3 Industrial Waste water treatment		To be fed into the design stage of the industrial plant	(SW3.1) Risk assessment study of industrial installations effluent to minimise impact and chance of accidental releases of industrial effluent to surface water.	Industry, SIZP, SHMU, PH, MH, VUVH

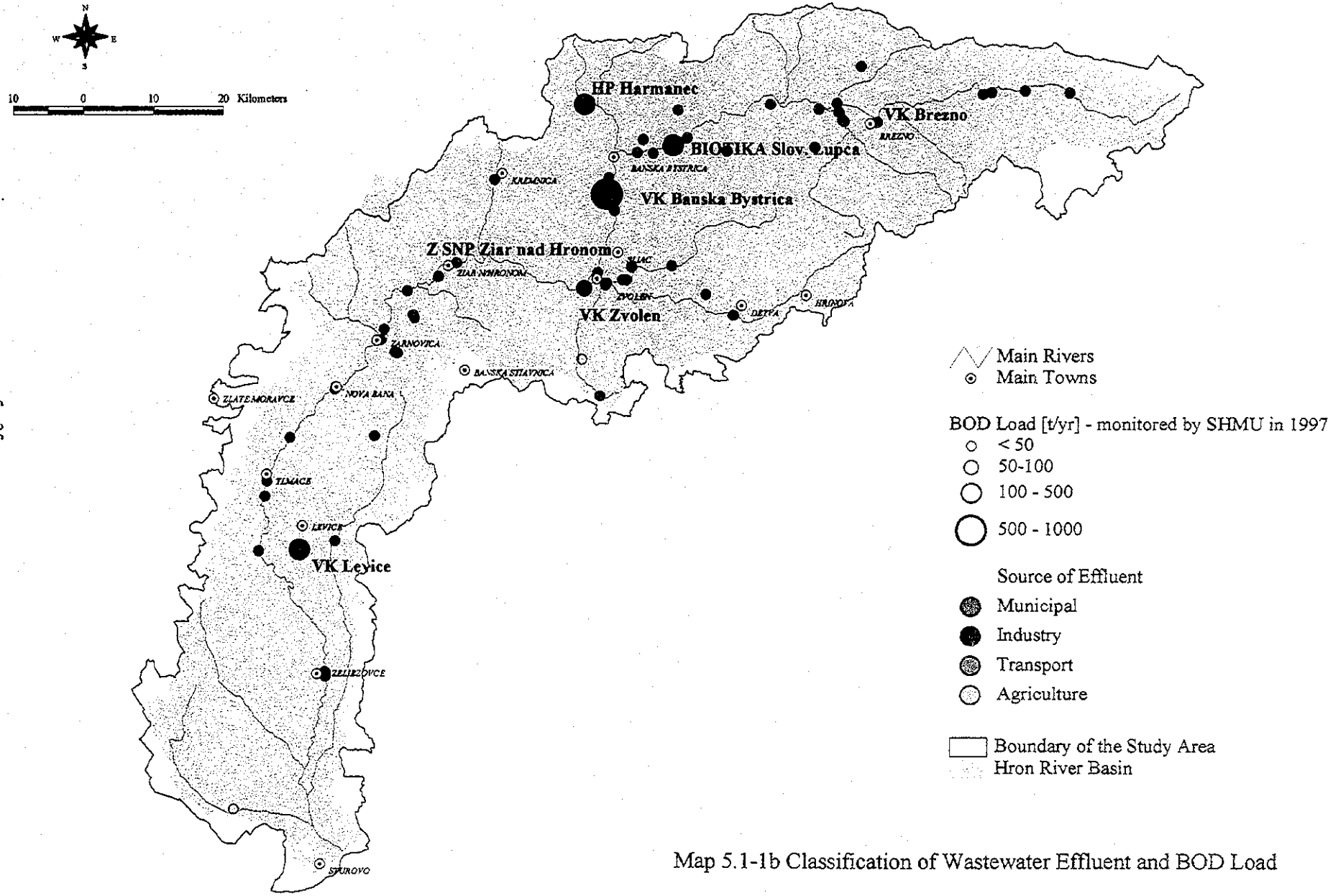
Issue	Objective	Target	Recommended measures	Key Agency
		Industrial plant's wastewater treatment systems effective enough to meet effluent standards set by Government Order 242/1993 Coll. of Laws up to the end of 2004 and EU Directive 91/227/EEC from 2005.	(SW3.2) Design and implementation of measures identified in Risk Assessment.	Industries, SIZP
	Improvement of industrial wastewater quality from each existing industrial plant.	Pollutants in existing Industrial plant's effluent should be reduced so as to comply with the Government Order No.242/1993 Coll. of Laws by 2002 and by 2005 with the EU Directive 91/271/EEC.	(SW3.3) Reduction of pollutants discharged from Biotika Slovenska Lupca, particularly organic pollution and the content of the ammonium ions through implementation of the project 'Ecologising Biotika'	Industry
			(SW3.4) In Bucina, Zvolen, improved treatment facilities for wastewater and solving of old loads liquidation (Slatina, Zolona) prior to discharge into the Hron to ensure compliance with the mentioned Slovak Order and EU Directive.	Industry
		To meet National and International permitted levels. (Government Order 242/1993 Coll. of Laws by 2002 and EU Directive 91/227/EEC by 2005)	(SW3.5) Monitoring of effluent quality and reporting of results to SIZP/Okres offices by the industries themselves to ensure compliance with standards occur.	Industry, SIZP, PH, Okres offices, VUVH
SW4 Institutional and Legal framework	Changes to legal framework to ensure improvement in industrial effluent quality	Compliance by 2005	(SW4.1) Larger factories have to comply with the EU's IPPC (Integrated Pollution Prevention and Control) Directive 96/61/EC.	MZP, Industry, SIZP, Okres office

Issue	Objective	Target	Recommended measures	Key Agency
		50% of small and medium industries by 2005	(SW4.2) Medium and small industries to establish Environmental Management Systems, certified under ISO 14 001.	MZP,Industry, SIZP, Okres office
	Improvement and /or development of sewerage treatment system.	Institutional framework to enable co-operation between neighbouring municipalities for joint sewerage treatment system by 2000 so that this possibility can also be looked at in feasibility studies (see W1)	(SW4.3) Coordinated proceedings of local self-government to enable construction of sewerage treatment systems for municipalities that would not, on their own be able to afford it.	MZP, Municipalities, SIZP, MZP
	Interaction and data sharing between the many institutions involved in the water quality management of the Hron River Basin	By summer 2000, quarterly meetings each year.	(SW4.4) Establishment of a River Basin Management Coordination Commission as a co-ordinating body. This could be set up as a co-ordinating body. This board could also meet to discuss and agree priority actions and investment programmes.	MZP, PH, StVak, ZsVak, SHMU, SIZP, State Health Institute, SAZP, Mesto, Kraj/Okres, NGOs and Industry Representatives

NOTE See Supporting Report for an example of a methodology for prioritising recommended measures

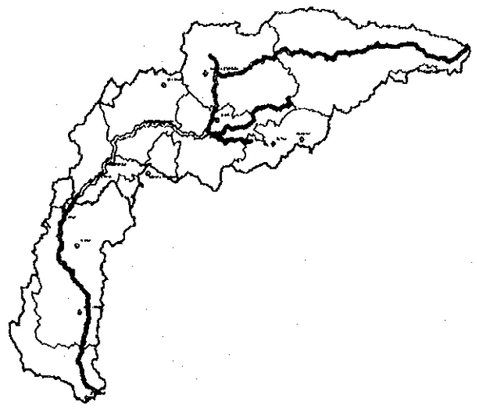


Map 5.1-1a Wastewater Effluent Locations

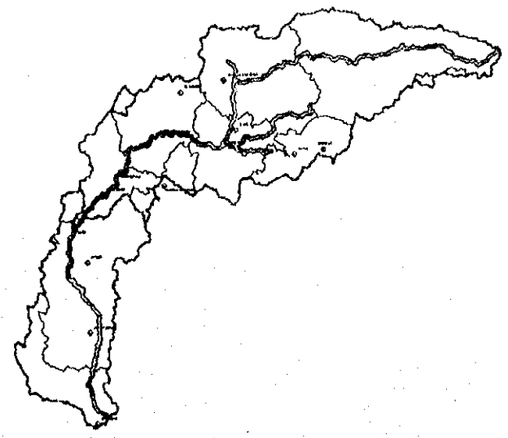


Map 5.1-1b Classification of Wastewater Effluent and BOD Load

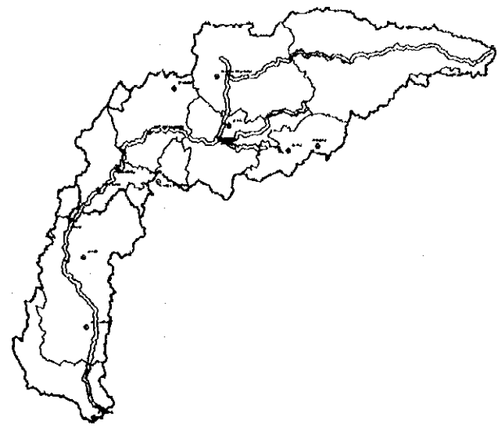
A: Oxygen Regime parameters



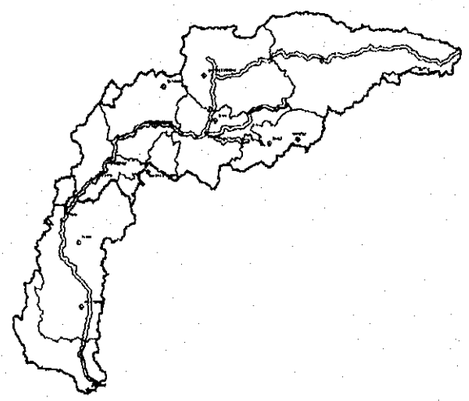
B: Chemical & Physical parameters - basic



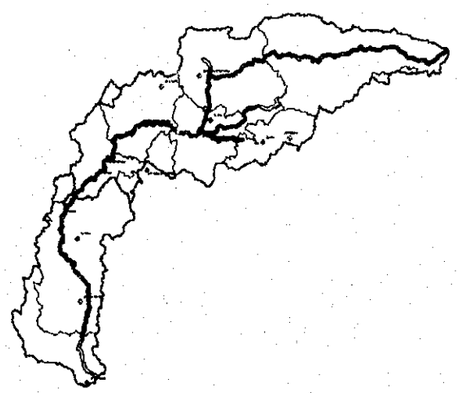
C: Chemical Parameters - supplementary



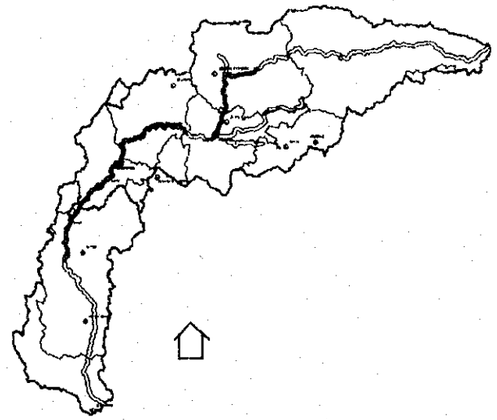
D: Heavy metals



E: Biological and Microbiological parameters



Integrated Evaluation of The State of Surface Water Quality



I class (very clean)
II class (clean)
III class (polluted)
IV class (very polluted)
V class (very high polluted)

State of Water Quality in the Hron River based on STN 75 7221(1996-1997)

No.	River	Profile	R. km	A.Oxygen Regime	B.Basic Chemical & Physical	C.Supplementary Chemical	D.Heavy Metals	B.Biological & Microbiological
H1	Hron	Valkovna	261.3	II-A2,4		V-C11	-	
H2	Hron	Polomka	243.4	II-A2,4		I	I	
H3	Hron	Brezno nad	224.8	II-A2		I	-	
H4	Hron	Valaska	217	II-A2,4		V-C11	II-D10	
H5	Cierny Hron	Ustie	0.05	II-A4		I	-	
H6	Hron	Nemecka	200.8	II-A2,4		I	II-D10	
H7	Hron	Salkova	181.4			II-C10	-	
H8	Hron	Banska Bystric	175.8			V-C11	-	
H9	Bystrica	Banska Bystric	2.1	II-A2,4		II-C4	II-D1,5,10	
H10	Hron	Sliac	161.1			V-C11	II-D10	
H11	Hron	Zvolen MB CC	153.6			V-C11	-	
H12	Hucava	Hrochoy	13.8	II-A2		I	-	V-B...
H13	Zolna	Ustie	0.5	II-A4			-	
H14	Neresnica	Ustie	0.3	II-A2,4			-	
H15	Slatina	Ustie	0.3	II-A2,4			II-D10	
H16	Hron	Budca	148.2	V-A4	V-B...	I	-	
H17	Hron	Ziar nad Hronc	131.5	V-A4		II-C10	IV-D10	
H18	Hron	Zarnovica	112	V-A4		II-C10	IV-D10	
H19	Hron	Tekovska Brez	88.9	V-A4		I	IV-D10	
H20	Hron	Kalna n. Hronc	63.7			V-C11	-	
H21	Sikenica	Ustie	2.7	V-A4		I	-	V-B...
H22	Hron	Kamenin	10.9		V-B...	I	-	
H23	Hron	Kamenica	1.7	II-A2,3,4				V-B...

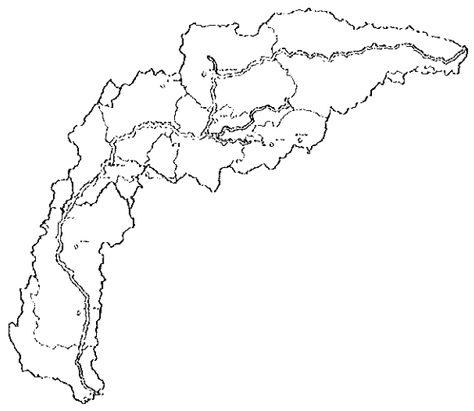
A2: BOD5
A4: CODCr
B1: pH
B5: SS
B8: NH4+-N
B11: organic N
B12: P
C9: ENP
C11: CL2
D1: Hg
D10: Zn
B3: Coliform bacteria

No.	River	Profile	R. km	A.Oxygen Regime	B.Basic Chemical & Physical	C.Supplementary Chemical	D.Heavy Metals	
H1	Hron	Valkovna	261.3			4		7
H2	Hron	Polomka	243.4					3
H3	Hron	Brezno nad	224.8					3
H4	Hron	Valaska	217			4		7
H6	Hron	Nemecka	200.8					8
H7	Hron	Salkova	181.4					6
H8	Hron	Banska Bystric	175.8			4		
H10	Hron	Sliac	161.1			4		
H11	Hron	Zvolen MB CC	153.6			4		
H16	Hron	Budca	148.2	4	4			8
H17	Hron	Ziar nad Hronc	131.5	4			4	
H18	Hron	Zarnovica	112	4			4	
H19	Hron	Tekovska Brez	88.9	4			4	
H20	Hron	Kalna n. Hronc	63.7			4		
H22	Hron	Kamenin	10.9		4			7
H23	Hron	Kamenica	1.7					9

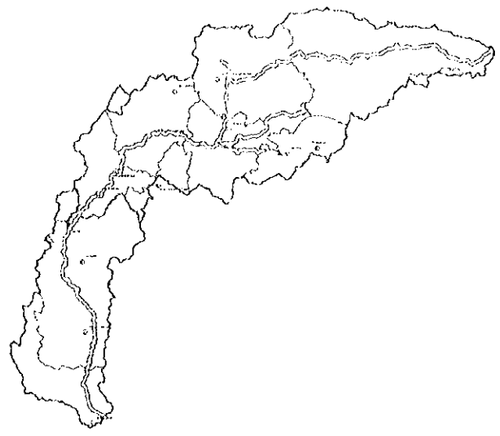
Map 5.1 - 2 Classification of Water Quality According to STN 75 7221 (Ref 19-9), in the Study Area

Source: Based on the data provided by SHMU (1997)

A: Oxygen Regime parameters



B: Chemical & Physical parameters - basic

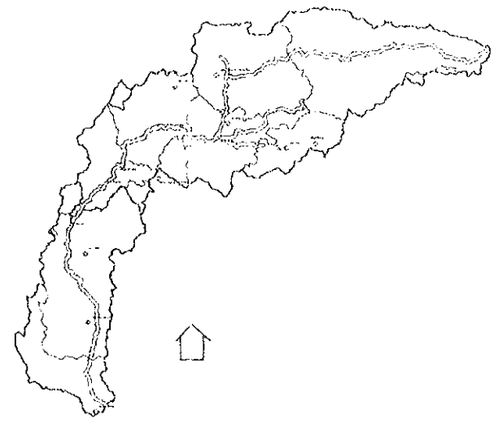


C: Chemical Parameters - supplementary

D: Heavy metals

E: Biological and Microbiological parameters

Integrated Evaluation of The State of Surface Water Quality



I class (very clean)
II class (clean)
III class (polluted)
IV class (very polluted)
V class (very high polluted)

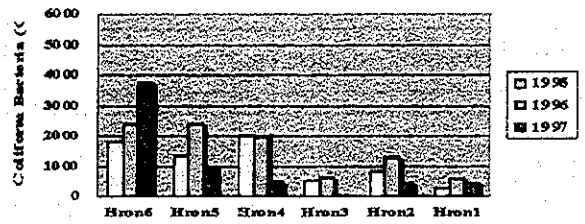
State of Water Quality in the Hron River based on STN 75 7221(1996-1997)

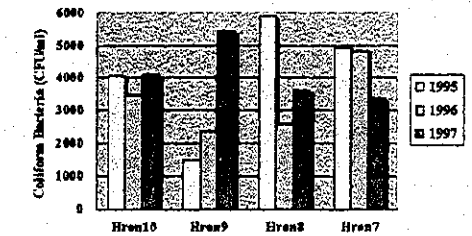
No	River	Profile	R. km	A Oxygen Regime	B Basic Chemical & Physical	C Supplementary Chemical	D Heavy Metals	E Biological & Microbiological
H1	Hron	Valkovna	26.3	II-A2,3,4	III-B1	IV-C11		V-B3
H2	Hron	Polomka	244.4	II-A2,4	III-B1	I	I	V-B3
H3	Hron	Brezno nad	224.8	II-A2	III-B1	I		V-B3
H4	Hron	Valaska	217	II-A2,4	III-B1,8,12	IV-C11	II-D10	V-B3
H5	Cierny Hron	Ustie	0.05	II-A4	III-B1,8,12			V-B3
H6	Hron	Nemecka	200.8	II-A2,4	III-B1,8,12	V-C11	II-D10	V-B3
H7	Hron	Salkova	181.4	III-A2,4	III-B1,8,12	II-C10	-	V-B3
H8	Hron	Banska Bystrica	175.8	III-A2,4	III-B1,8,12	IV-C11	-	V-B3
H9	Bystrica	Banska Bystrica	2.1	III-A2,4	III-B1,8	II-C4	II-D1,5,10	V-B3
H10	Hron	Sliac	161.1	III-A2,4	V-B1,8	IV-C11	II-D10	V-B3
H11	Hron	Zvolen MB CC	153.6	III-A2,4	III-B1,5,8,12	IV-C11	-	V-B3
H12	Hocava	Hrochoy	13.8	II-A2	III-B1,8	-	-	IV-B3
H13	Zolna	Ustie	0.5	II-A4	III-B1,5,8,12	V-C11	-	V-B3
H14	Necenica	Ustie	0.5	III-A2,4	III-B1,5,8,12	III-C11	-	V-B3
H15	Slatina	Ustie	0.3	III-A2,3	III-B1,8,12	V-C11	II-D10	V-B3
H16	Hron	Budca	148.2	IV-A4	IV-B5	I	-	V-B3
H17	Hron	Ziar nad Hronc	131.5	IV-A4	V-B5	II-C10	IV-D10	V-B3
H18	Hron	Zamovica	112	IV-A4	V-B5	II-C10	IV-D10	V-B3
H19	Hron	Tekovska Brez	88.9	IV-A4	V-B5	I	IV-D10	V-B3
H20	Hron	Kalna n. Hronc	63.7	III-A2,4	V-B5	IV-C11	-	V-B3
H21	Sikenica	Ustie	2.1	IV-A4	V-B5	I	-	IV-B3
H22	Hron	Kamenin	10.9	III-A4	IV-B11	I	-	V-B3
H23	Hron	Kamenica	1.7	III-A2,3,4	III-B1,7,8,12	III-C9	III-D1,10	IV-B3

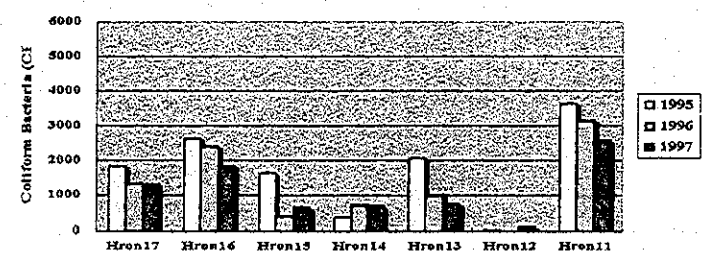
A2: BSK5 A4: CODCr
B1: pH B5: SS B8: NH4+-N B11: organic N B12: P
C9: T-P C11: CL2
D1: Hg D10: Zn
B3: C. coliform bacteria

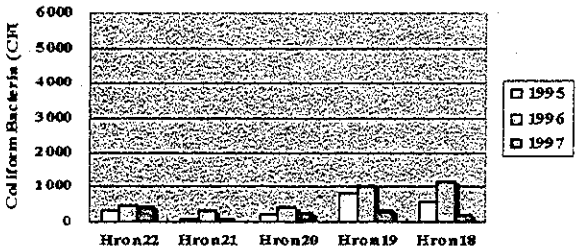
No	River	Profile	R. km	A Oxygen Regime	B Basic Chemical & Physical	C Supplementary Chemical	D Heavy Metals	Total Score
H1	Hron	Valkovna	26.3		3	4		7
H2	Hron	Polomka	244.4		3			3
H3	Hron	Brezno nad	224.8		3			3
H4	Hron	Valaska	217		3	4		7
H6	Hron	Nemecka	200.8		3	5		8
H7	Hron	Salkova	181.4	3	3			6
H8	Hron	Banska Bystrica	175.8	3	3	4		10
H10	Hron	Sliac	161.1	3	5	4		12
H11	Hron	Zvolen MB CC	153.6	3	3	4		10
H16	Hron	Budca	148.2	4	4			8
H17	Hron	Ziar nad Hronc	131.5	4	5		4	13
H18	Hron	Zamovica	112	4	5		4	13
H19	Hron	Tekovska Brez	88.9	4	5		4	13
H20	Hron	Kalna n. Hronc	63.7	3	5	4		12
H22	Hron	Kamenin	10.9	3	4			7
H23	Hron	Kamenica	1.7		3	3	3	9

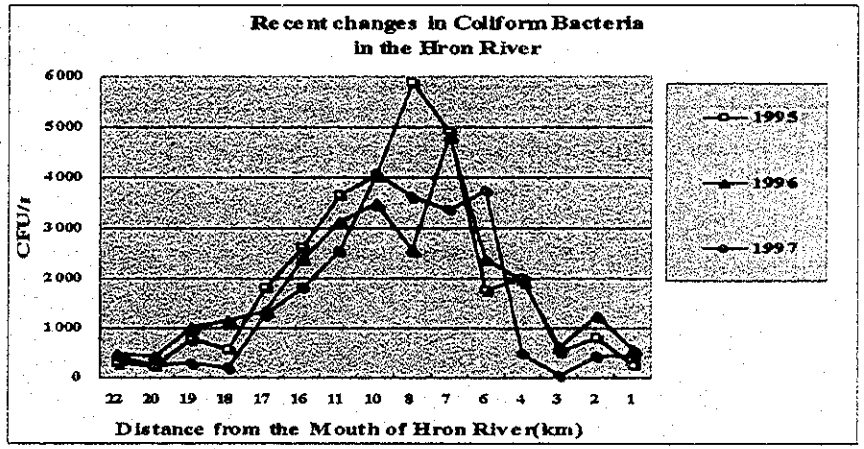
Map 5.1 - 2 Classification of Water Quality According to STN 75 7221 (Ref 19-9), in the Study Area Source: Based on the data provided by SHMU (1997)

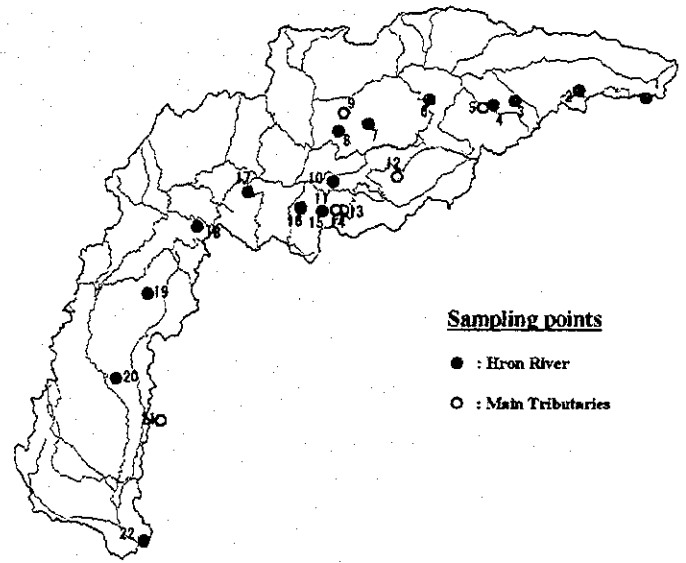






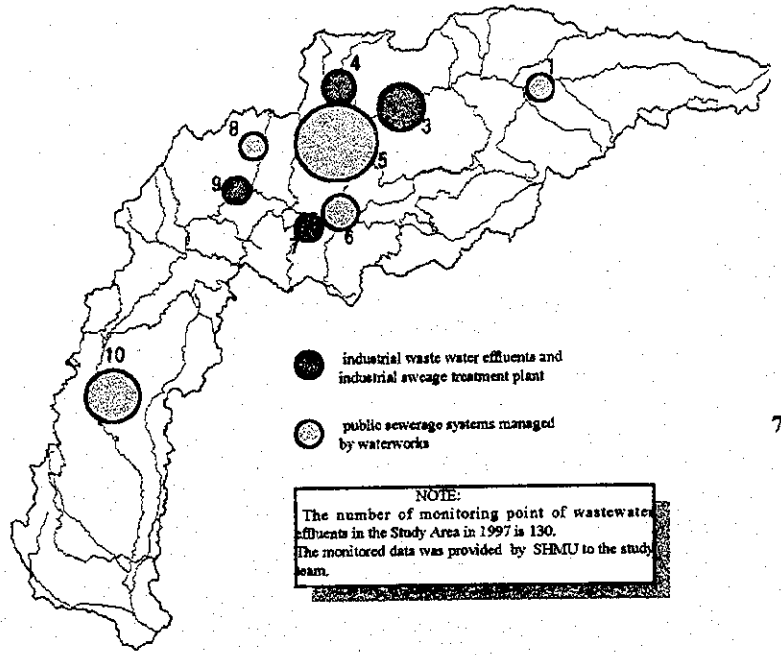


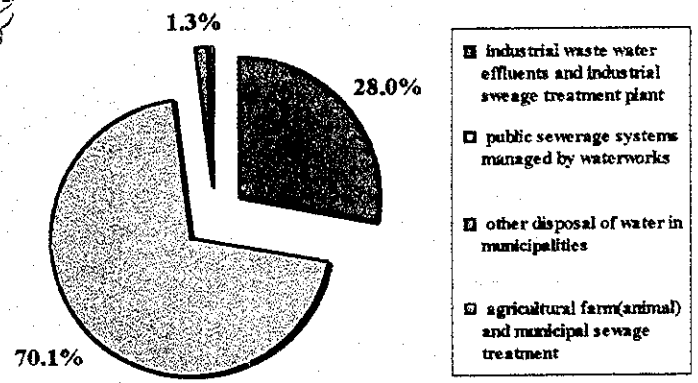




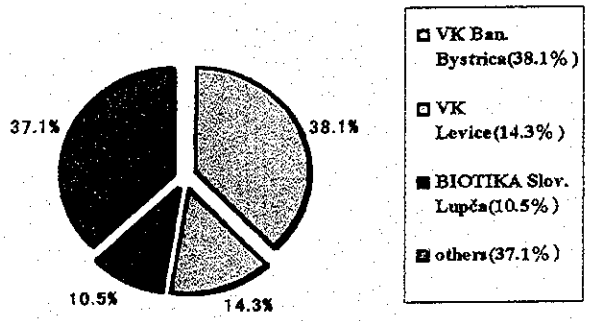
Map 5.1 - 3 Recent Changes in Coliform Bacteria in the Study Area

Source: Based on the digital data provided by SHMU

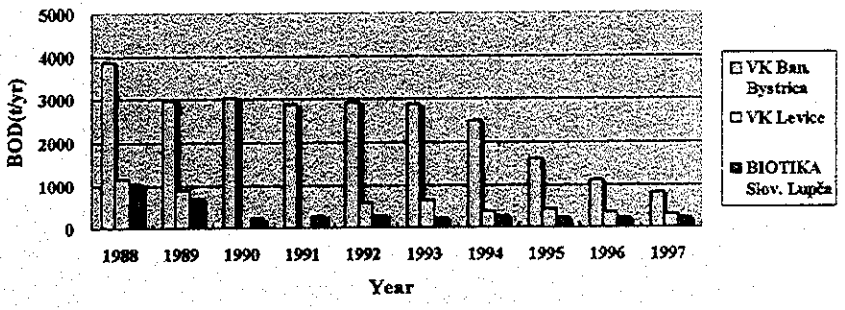




Ratio of BOD Load based on the category of wastewater effluents in the Study Area in 1997



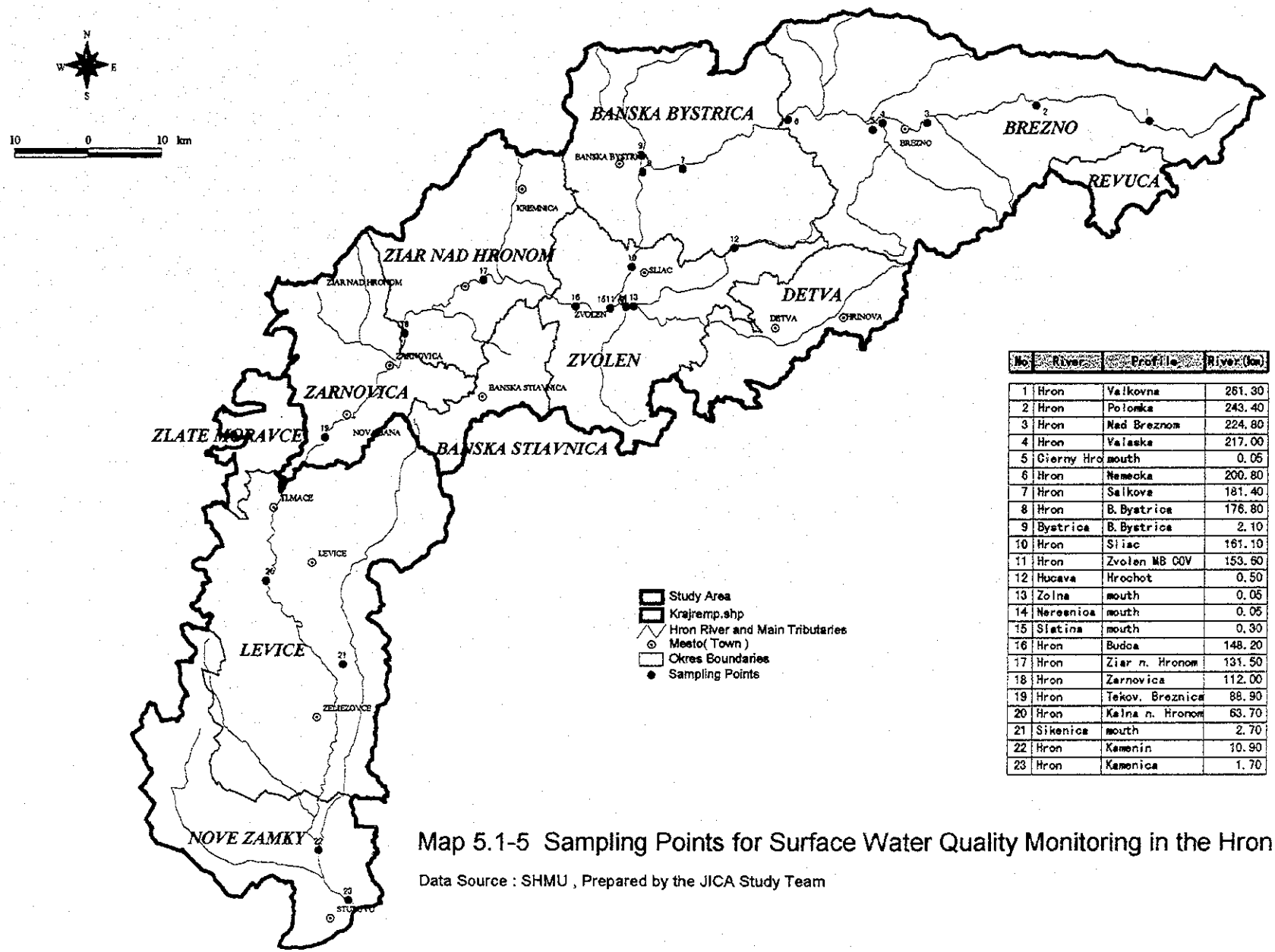
Major wastewater effluent sources of BOD Load in the Study Area in 1997



Change of BOD Load of major wastewater effluents for the past ten years

Map 5.1 - 4 BOD Load of Wastewater Effluent in the Study Area

Source: Based on the digital data provided by SHMU



No.	River	Profile	River(km)
1	Hron	Valkovna	261.30
2	Hron	Polomka	243.40
3	Hron	Nad Breznom	224.80
4	Hron	Valaska	217.00
5	Cierny Hro	mouth	0.05
6	Hron	Nemecka	200.80
7	Hron	Salkova	181.40
8	Hron	B.Bystrica	176.80
9	Bystrica	B.Bystrica	2.10
10	Hron	Sliac	161.10
11	Hron	Zvolen MB COV	153.60
12	Hucava	Hrochot	0.50
13	Zolna	mouth	0.05
14	Neresnica	mouth	0.05
15	Slatina	mouth	0.30
16	Hron	Budca	148.20
17	Hron	Ziar n. Hronom	131.50
18	Hron	Zarnovica	112.00
19	Hron	Tekov. Breznica	88.90
20	Hron	Kalna n. Hronom	63.70
21	Sikenica	mouth	2.70
22	Hron	Kamenin	10.90
23	Hron	Kamenica	1.70

Map 5.1-5 Sampling Points for Surface Water Quality Monitoring in the Hron River Basin

Data Source : SHMU , Prepared by the JICA Study Team