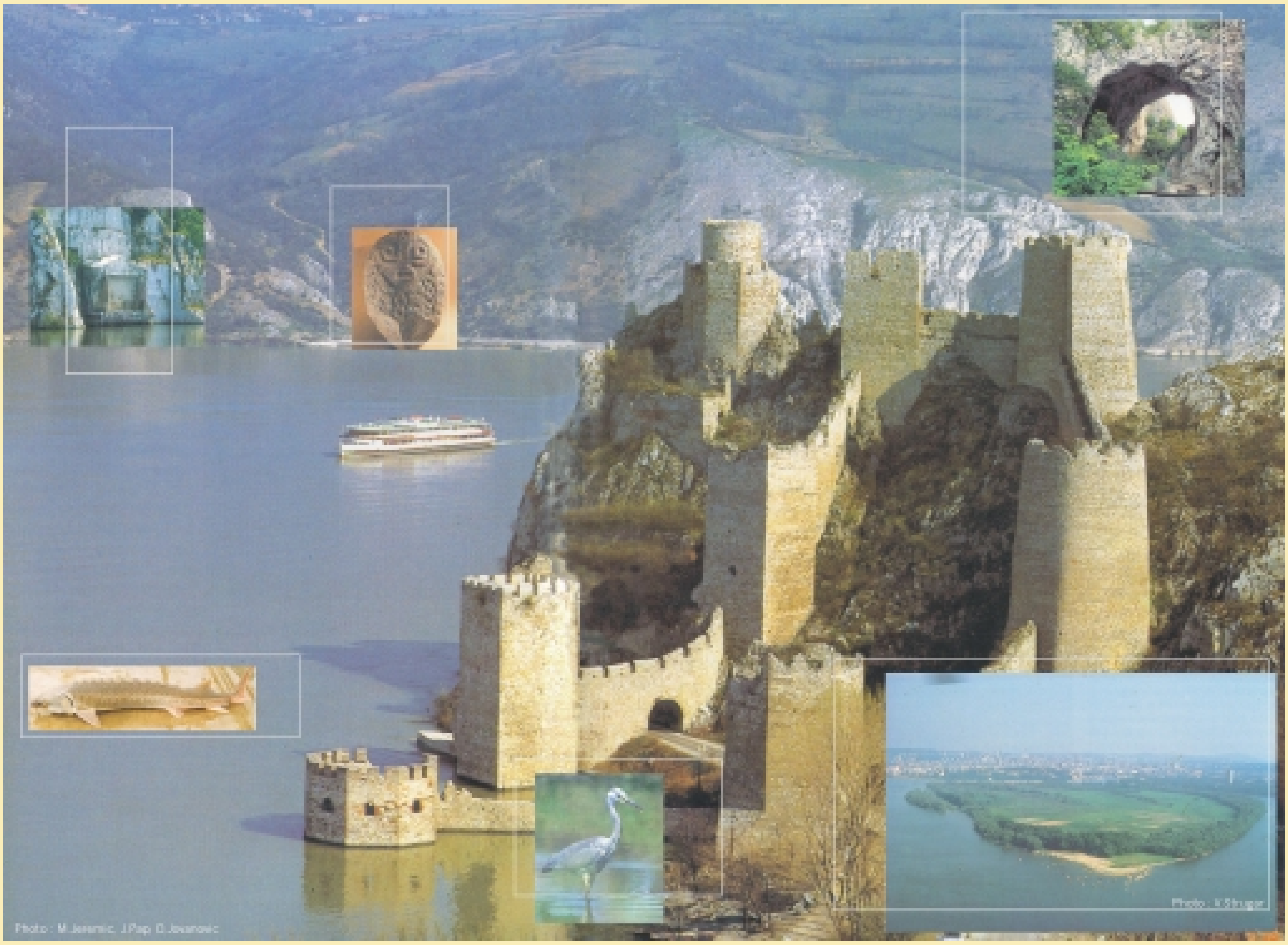
DANUBE POLLUTION REDUCTION PROGRAMME

NATIONAL REVIEWS 1998
FEDERAL REPUBLIC OF YUGOSLAVIA

TECHNICAL REPORTS

Part C: Water Quality

Part D: Water Environmental Engineering



FEDERAL MINISTRY FOR DEVELOPMENT, SCIENCE AND ENVIRONMENT

in cooperation with the

Programme Coordination Unit
UNDP/GEF Assistance

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Preface

The National Reviews were designed to produce basic data and information for the elaboration of the Pollution Reduction Programme (PRP), the Transboundary Analysis and the revision of the Strategic Action Plan of the International Commission for the Protection of the Danube River (ICPDR). Particular attention was also given to collect data and information for specific purposes concerning the development of the Danube Water Quality Model, the identification and evaluation of hot spots, the analysis of social and economic factors, the preparation of an investment portfolio and the development of financing mechanisms for the implementation of the ICPDR Action Plan.

For the elaboration of the National Reviews, a team of national experts was recruited in each of the participating countries for a period of one to four months covering the following positions:

- Socio-economist with knowledge in population studies,
- Financial expert (preferably from the Ministry of Finance),
- Water Quality Data expert/information specialist,
- Water Engineering expert with knowledge in project development.

Each of the experts had to organize his or her work under the supervision of the respective Country Programme Coordinator and with the guidance of a team of International Consultants. The tasks were laid out in specific Terms of Reference.

At a Regional Workshop in Budapest from 27 to 29 January 1998, the national teams and the group of international consultants discussed in detail the methodological approach and the content of the National Reviews to assure coherence of results. Practical work at the national level started in March/April 1998 and results were submitted between May and October 1998. After revision by the international expert team, the different reports have been finalized and are now presented in the following volumes:

Volume 1:	Summary Report
Volume 2:	Project Files
Volume 3 and 4:	Technical reports containing:
	- Part A : Social and Economic Analysis
	- Part B : Financing Mechanisms
	- Part C : Water Quality
	- Part D : Water Environmental Engineering

In the frame of national planning activities of the Pollution Reduction Programme, the results of the National Reviews provided adequate documentation for the conducting of National Planning Workshops and actually constitute a base of information for the national planning and decision making process.

Further, the basic data, as collected and analyzed in the frame of the National Reviews, will be compiled and integrated into the ICPDR Information System, which should be operational by the end of 1999. This will improve the ability to further update and access National Reviews data which are expected to be collected periodically by the participating countries, thereby constituting a consistently updated planning and decision making tool for the ICPDR.

UNDP/GEF provided technical and financial support to elaborate the National Reviews. Governments of participating Countries in the Danube River basin have actively participated with professional expertise, compiling and analyzing essential data and information, and by providing financial contributions to reach the achieved results.

The National Reviews Reports were prepared under the guidance of the UNDP/GEF team of experts and consultants of the Danube Programme Coordination Unit (DPCU) in Vienna, Austria. The conceptual preparation and organization of activities was carried out by **Mr. Joachim Bendow**, UNDP/GEF Project Manager, and special tasks were assigned to the following staff members:

- Social and Economic Analysis and Financing Mechanisms: **Reinhard Wanninger**, Consultant
- Water Quality Data: **Donald Graybill**, Consultant,
- Water Engineering and Project Files: **Rolf Niemeyer**, Consultant
- Coordination and follow up: **Andy Garner**, UNDP/GEF Environmental Specialist

The **Yugoslavian National Reviews** were prepared under the supervision of the Country Programme Coordinator, **Mr. Zoran Cukic**. The authors of the respective parts of the report are:

- Part A: Social and Economic Analysis: **Mr. Miroslav Tanaskovic**
- Part B: Financing Mechanisms: **Mr. Milorad Filipovic**
- Part C: Water Quality: **Mr. Zoran Cukic**
- Part D: Water Environmental Engineering: **Mr. Milorad Miloradov**

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Part C

Water Quality

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1. Summary

The National Report on the pollution and protection of the waters within the Danube River Basin (DRB) in FR of Yugoslavia (FRY), is prepared in a specific political and economic circumstances, which certainly exerts influence on the water sector.

Despite being open for the cooperation from the beginning of the UNDP/GEF DRB Pollution Reduction Programme, the FRY was included in given the Programme only at the end of 1997 or, more exactly, in their Phase II, thus lagging a few years behind the majority of the Danube countries.

Above mentioned facts exerts influence on the analysis of actual and future pollution emission. Namely, the greater part of reliable data and analyses stems from the period prior to 1992, when industry was operating at almost full capacity, whereas in the period 1994-1997, productive capacities are used only 25-40%. Also, available demographic data are those provided by the 1991 census (the next census is planned for 2001), although the period after 1991 was marked by significant migrations and demographic changes. A large number of refugees came into the country (500,000-750,000, according to the official data of the Committee for Refugees) from the former Yugoslav republics. In addition, a part of the population immigrated from the country.

In order to provide as better as possible picture of the pollution emission in the given circumstances, the analysis was done on the basis of the data collected up to 1992. This was done for the reasons as follows:

1. The data on pollution emission in this report was not seen as the balancing parameter for the analyzed period (i.e.1994-97) but as the planning parameter needed for the projection of Water Pollution Control measures for the coming 10 years period.
2. The data on the pollution emission after 1992 are modest and unreliable, while the emission itself is considerably reduced due to a significant fall in industrial production;
3. It is expected that industrial production in the FRY will reach its 1991 level only about 2005, so that the data from the period up to 1992 reflect more realistically the situation for the planning period covered by Phase II of the Strategic Action Plan for the Danube River.

This approach seems to be much more correct than one based on the actual pollution emission, which is estimated to be 45-55 % lower than it was before the year 1992 (as presented in this Report). In other hand, the data on the ambient water quality are presented for the period 1994–1997 as it was needed for the comparison with the data from other countries as well as for the purposes of DRB Water Quality Analysis.

It has to be noted that the link between emission and imission is not strong due to above mentioned approach in pollution emission analysis as well as for a number of other reasons:

- lack of the statistically reliable time series on water quality

  (frequency of sampling was low because of budgetary limitation)
- lack of high-quality chemicals and reliable sophisticated equipment, which would ensure a better labs performances and consequently better data.
- inadequate positioning of gauging stations

  (the majority of gauging stations were established many years ago, in the period when water pollution was not of interest, so that the basic criterion for selecting the sites for these stations was measurement of flow on the suitable section of the rivers. Monitoring of water quality began later on, but already established stations were not positioned as required for the proper monitoring of water pollution).

- unfavourable periods of sampling

  (sampling frequency was not adjusted with occurrence of peak flow so periods of flushing out of accumulated river sediments as well as the periods of large urban and agricultural land run-off were missed).
- lack of the research needed for the analyses of the linkage between the pollution emission, processes in the recipients and its observed water quality

1.1. Updating, Evaluation and Ranking of Hot Spots

Not updating but only the evaluation and ranking of hot spots was done because this is the first time FR Yugoslavia got the opportunity to prepare the National Review.

In spite of the severe decreasing of industrial production (consequently the decreasing of pollution discharge) in FRY after the year 1992, the evaluation was done on the basis of data related to the period before this year. As it is mentioned above, this approach seems to be more correct than one based on the actual pollution emission, which is estimated to be 45-55 % lower than it was before the year 1992.

In ranking of priorities the focus was placed on the large cities because these are fixed permanent pollution sources whose emission increases following the rules of urbanization. Also, the analysis was focused onto several large abandoned industries and livestock farms.

It is important to emphasize that in the consideration of national water pollution control (WPC) strategy the attention has been given to the control of emission of toxic substances (i.e. heavy metals, toxic organics, etc.), reduction of biodegradable organic load and reduction of microbial pollution. Not strong attention was given to the nutrients (phosphorus and nitrogen) removal in national water pollution control strategy so it is to be adjusted in accordance with regional approach to the WPC.

The ranking of municipal hot spots stemmed from the analysis of the structure of settlements and demographic analyzes within the Federal Republic of Yugoslavia (FRY). Namely, the largest part (88%) of 6999 settlements (actual and potential point sources) within the Danube River watershed in FRY are mostly of rural type, with population of less than 2000. The settlements with 2000 to 10000 inhabitants (mostly of rural or mixed type) make next 9.8% of the total number of settlements. Only 15-20% of these settlements (mostly larger ones), have the public sewage systems.

These above mentioned smaller settlements (besides several of its located in vicinity of sensitive areas) are not the target group of priorities because of its “diffuse” character and large investment needed for the sewage systems construction. Also, it is estimated in this horizon, that the benefit of reduction of pollution emission from smaller settlements is low comparing with the high investment for the construction of small wastewater treatment plants (WWTP) for the high specific investment cost.

Settlements with over 10,000 inhabitants (including the largest ones) make only 2,2% of the total number of all settlements within the Danube watershed in FRY, but these ones comprise more than 90% of total pollution load from municipal point sources. It has to be noted that most of the small and medium industry (particularly foodstuff processing) are located in these settlements.

Considering all of above mentioned, the future Water Pollution Control activities planned for the horizon 2010 are focused on settlements with more than 15,000 people, especially concerning the construction of WWTPs. The exception are the settlements where construction of WWTPs is forced by some other criteria (sensitivity of water recipient, proximity of sensitive water users or recreation zone, proximity of drinking water resource, protection of reserve of nature, etc.).

Regarding to the agricultural pollution the attention was given to the larger pig farms as the most significant sources of agricultural pollution within the Country. In general, these are pig farms breeding more than 10,000 porkers per cycle. Several of these farms causing serious degradation of the environment are ranked as the top priorities.

Regarding to the “diffuse” agricultural pollution it is estimated it will not be a general but local problem (i.e. in the areas of highly intensive agriculture). The average consumption of fertilizers was less than 100 kg per ha of arable land for the last 10 years so the land in FRY is generally not saturated by nutrients and still having large absorbing capacity of nutrients (particularly phosphates). The area-specific nitrogen and phosphorous export was estimated to be 0.1 – 0.15 tN/km^2 /y and 0.015 - 0.025 tP/km^2 /y respectively.

Concerning the industrial pollution, the several large abandoned industries (wood and paper, food processing, chemical and fertilizers industry), thermo-power plants (ash dump sites) and mining (flotation dumps) are ranked as the priority hot spots.

1.2. Updating, Analysis and Validation of Water Quality Data

The Yugoslav part of the Danube River Basin, covers an area of about 89,000 km^2, with about 9,000,000 inhabitants. The FRY comprises about 11% of DRB area and about 11% of population, but its position in the DRB is significant since the confluences of main Danube’s tributaries, draining an area of 360,000 km^2 (about 45% of the total DRB area), lie along the part of Danube River course crossing FRY.

It is important to note that the flow of the Danube increases 2.5 times along this part of its watercourse but this water brings into FRY the large quantities of fresh or transformed pollutants (or matters emanated from pollution such as algal biomass is) as well as the suspended sediments generated by erosion. The large part of these pollutants and suspended sediments are retained into Iron Gate I and Iron Gate II reservoirs, or are transformed along the Danube course and other transboundary watercourses (20 in total) entering the territory of the FRY. It is estimated that each year about 580-620,000 t of BOD_5, about 380-450,000 t of nitrogen in various forms, about 25-30,000 t of phosphorus enters the territory of the FRY. In addition, about 14 million tons of sediments partly containing adsorbed nutrients, heavy metals, toxic organic matter, oil and oil products, etc., enters the territory of the FRY. The conclusion can be made that over 95% of water volume enters FRY from neighboring countries has the modest quality which are not in compliance with national standards for ambient water quality. In other hand the water quality downstream of Iron Gates is much more better than average one observed in transboundary rivers entering FRY thanks to the self-purification processes in Iron Gates.

There is rather developed legislature in Water Sector (Federal Law on Water Regime, Law on Waters of each Republic, etc.) but most of the regulations and standards emanated from it (the categorization of watercourses, the classification of waters, etc.) are rather old and have to be renovated.

The regulations and standards for ambient waters (recipients) are proposed for average monthly low flow (return period of 20 years). Although the regulations and standards for ambient waters are rather developed, there are no standards proscribed for effluents discharging into recipients. The effluents criteria use to be established (by responsible water authority) for every given case following the criteria proposed for the given section of recipient.

Wastewater and effluents can be tested by only laboratories, which meet the proscribed requirements (premises, personnel, equipment) and have the license issued by the accredited body. It has to be noted that the policy of issuing of permissions for the testing, which would contribute to a better performance of labs, has not been formulated yet.

The methods of water quality analysis are prescribed by JUS ISO standards, but there is no reliable system of an external control of laboratory work and the checking of the accuracy of the data and preciseness of the work done by using official secondary standards, especial “blind” samples, etc. The laboratories themselves carry this out. It is important to point out that the labs are not obliged to keep a part of the samples in a frozen state, so its can be subsequently checked out if needed.

The water quality data published in Hydrological Annuals (Part-Water Quality) for the years; 1994,1995,1996 and 1997 are used for the analyses of ambient water quality.

In order to extract as better as possible base for presentation of ambient water quality, more than one third of among 168 gauging stations in Danube River Basin using for water quality monitoring, were analyzed. The most relevant gauging stations are chosen for the analyzes, i.e. all existing gauging stations at the Danube watercourse, all transboundary gauging stations as well as all gauging stations at the mouth of relevant rivers and canals have been analyzed for nutrients, oxygen related parameters as well as for several heavy metals and organics (i.e. phenols and mineral oil).

It has to be pointed out that the ambient water quality profile during the period of 1994-97 does not fully represent situation as it was before the large economic and political changes within Danube River Basin started at the beginning of the last decade of this century. Slightly better water quality than observed in the period before 1992 is supposed to be caused by decreasing of industrial and agricultural production in the middle and lower part of Danube River Basin as well as by decreasing of industrial and agricultural production in FRY.

Unfortunately, given the economic situation has been causing significant decreasing of research funds to support serious field investigations needed; for the analysis of the processes in receiving waters, for establishing and for clarifying the linkage among pollution emission, pollution discharge and imission data observed trough routine ambient water quality monitoring. Additional research is needed for the large tributaries (i.e. Sava, Tisa, and Velika Morava) and particularly for the Danube River as a giant natural bio-reactor which corrects absence of serious pollution reduction measures in upstream part of watershed as well as absence of these in the FRY. But the price of pollution coming from large area of 560,000 km^2, being paid in Iron Gate Reservoirs which have been playing the role of the guard of Danube Delta and Black Sea ecosystem from being degraded, for many years. In spite of a large self-purification capacity of Danube the permanently increasing burden of pollution and sediments accumulating in Iron Gate Reservoirs (particularly in Iron Gate I) has been causing the adverse changes of water quality and ecosystem in Iron Gate Reservoirs. As observed, its occur slowly but permanently so a well established long time monitoring of water, sediments and biota in Iron Gate Reservoirs as well as the research of the processes occur is of great international and regional importance. It is to be supposed that the lack of reliable data produced by this manner as well as the lack of research of the processes along in the Yugoslav-Romanian sector of Danube (i.e. Iron Gates reservoirs) could disable the proper regional action as well as the validation of Danube River Water Quality Model, which is under consideration.

2. Updating of Hot Spots

There was no updating of hot spots because this was the first time FR Yugoslavia is included in Danube River Basin Reduction Pollution Programme.

2.1. General Approach and Methodology

The general approach as well as the methodology is adjusted, as much as it was possible, following the instructions given in the Danube River Reduction Pollution Programme.

There are many of hot spots of various priorities so an effort was done to extract the most relevant ones regarding to the health and environmental risks as well as regarding to the Pollution of a Regional importance.

In order to provide as much as correct picture of the pollution emission in the given circumstances, the analysis was done on the basis of the data collected up to 1992. This was done for the reasons as follows:

1. The pollution emission in this report was not seen as the balancing parameter for the analyzed period (i.e.1994-97) but as the planning parameter needed for the projection of Water Pollution Control measures for the coming 10 years period.
2. The data on the pollution emission after 1992 are modest and unreliable, while the emission itself is considerably reduced due to a significant fall in industrial production;
3. It is expected that industrial production in the FRY will reach its 1991 level only about 2005, so that the data from the period up to 1992 reflect more realistically the situation for the planning period covered by Phase II of the Strategic Action Plan for the Danube River.

This approach seems to be more correct than one based on the actual pollution emission which is estimated to be 45-55 % lower than it was before the year 1992 (presented in this Report).

2.1.1. Evaluation of Existing Hot Spots

The evaluation of existing hot spots was done following the instructions given in the Danube River Pollution Reduction Programme. The following criteria were used in analysis:

- Size of source of pollution
- Implication of the pollution emission on the sanitary and environmental situation in sub-region
- Transboudary effects (direct or indirect)
- Vulnerability of nearby downstream users
- Environmental sensitivity of downstream river stretch
- Ratio; Wastewater / Receiving water discharge

It is important to point out that the settlements as well as the industries having suitable Wastewater Treatment Plants are not considered as the hot spots.

2.1.2. Deletion of Existing Hot Spots

There was no deletion of hot spots because this was the first time FR Yugoslavia is included in Danube River Basin Reduction Pollution Programme.

2.1.3. Addition of Hot Spots

There was no addition of hot spots because this was the first time FR Yugoslavia is included in Danube River Basin Reduction Pollution Programme.

2.1.4. Ranking of Hot Spots

In the ranking of existing hot spots the main effort was done how to compromise local, national and transboundary level. The ranking of hot spots is done following given the instructions for preparing of the National Review as it is mentioned above. The transboundary effects were primarily analyzed but the national needs are also considered as an important element of the analysis supposing that every large “hot spot” contributes in pollution on the regional level.

Among quiet a number of municipal hot spots, the importance was given to the large Cities, particularly these ones whose pollution load overcomes 50,000 p.e. The importance was also given to the settlements discharging pollution upstream of vulnerable zones (resources of drinking water, recreation areas, protected reserve of nature, etc.) as well as to the vulnerable recipients (i.e. lakes, reservoirs).

As it is mentioned above, the existing municipal WWTPs are not seen as the hot spots besides, some of its which need reconstruction and upgrading. Concerning the Agricultural hot spots the importance was given to the large pig farms located in vicinity of existing or potential water resources as well as in vicinity of recipients. The pig farms where wet method of farm cleaning and manure handling is practiced are seen as the hot spots of high priority.

Regarding to the Industrial hot spots the importance was given to the larger abandoned industries (wood and paper, food processing, chemical industry and fertilizers production), thermo-power plants (i.e. ash dump sites) and ores processing (flotation dumps). It is important to point out that the strategy for Water Pollution Control of Industry has to be set flexibly due to the uncertainty regarding the fate of a number of industries as well as due to real needs of restructuring of existing industrial capacities and introduction of new advanced (environment friendly) technologies instead of old ones.

It is to be point out that the importance in transboundary consideration has to be given to the so called “Hot Lines” i.e. heavily polluted rivers entering FRY from neighboring countries or leaving FRY (e.g. Timok River) but there is no category of “hot line” presumed in instructions for preparing of the National Review. Let us mentioned in that direction that 17 smaller rivers and canals (3 from Hungary, 9 from Romania, 3 from Bulgaria, 2 from Croatia) besides the rivers; Danube, Tisza, Sava and Drina directly enter FRY. Most of its are moderately to heavily polluted. The most serious problems that need urgent action are Bega Old River and Bega Canal.

Also, Timok River (97% of watershed at FRY territory) that makes 19 km of FRY – Bulgaria State border before it empties Danube can be treated as the “hot line” where urgent action is needed.

2.1.5 Map of Hot Spots

The Maps of Municipal, Agricultural and Industrial Hot Spots are given in Annex (Fig. 2.-1; Fig. 2.-2 and Fig. 2.-3). Besides these maps representing all selected hot spots, the estimated total amount of pollution within Danube Watershed in FRY is shown in the table 2.1.-1.

The map showing distribution of existing Municipal Wastewater Treatment Plants (total treatment capacity 1,250,000 p.e.) is also presented (Fig. 2.-4) in order to give better insight in existing situation as well as to mark the location of WWTPs where upgrading (or enlarging of WWTP) is needed.

2.2. Municipal Hot Spots

The Municipal Hot Spots were of the top interest in this analysis, as the municipalities are the main permanent source of pollution of recipients increasing the waste load following the rules of urbanisation.

There are 6999 Settlements and Communities within the Danube watershed in FRY. Its distribution by size is shown in the table as follows:

Size of Settlement	Number of settlements	% of Total	Country side	City of Belgrade
< 2 000	6158	87.98	6051	107
2 000 -5 000	454	6.49	424	30
5 000 - 10 000	236	3.37	226	10
10 000 - 15 000	67	0.96	64	3
15 000 -50 000	54	0.77	47	7
50 000 - 100 000	19	0.27	16	3
> 100 000	11	0.16	5	6

The distribution of communities within the City of Belgrade metropolitan area is presented in separate column since most of them are comprised (or will be comprised) by one of the four existing (or planned) municipal sewage systems.

As it can be seen, the largest number (around 6158) of 6999 settlements (actual and potential point sources) within the Danube River watershed in FRY are mostly of rural type, with population of less than 2.000.

Settlements with 2.000 to 10.000 inhabitants (mostly of rural or mixed type) make next 9.8% of the total number of settlements. Only 15 -20% of these settlements (mostly larger ones) have the sewage systems.

These above mentioned smaller settlements (besides several of its located in vicinity of vulnerable zones) are not the target group of National Pollution Control Programme because of its “diffuse” character as well as because of the high specific investment cost for construction of smaller WWTP.

Settlements with over 10 000 inhabitants (including the largest ones) make only 2.2% of the total number of all settlements within the Countryside of Danube watershed in FRY, but these ones discharge more than 95% of total municipal point sources pollution into recipients.

Just 1.2 % of total number of settlements in the Countryside is these with more than 15 000 inhabitants but participating more than 85% of total pollution load. Bearing this in mind as well as the financing potential of the Country, the National Water Pollution Control Programme up to 2021 year is focused on this group of settlements. The priority is given to the larger settlements and also to ones located within the vulnerable zones (e.g. upstream of impoundments of drinking water resources, upstream of recreational zones, at the borders of protected nature areas, etc.) as well as to the settlements discharging wastewater (or effluents) in tributaries of lakes or reservoirs.

The Ranking of Municipal Hot Spots that was carried out in preparing of the National Review was balanced between the Regional Concept (protection of the Black Sea) where long term effects (i.e. enrichment of nutrients, accumulation of heavy metals, etc.) are the most important, but the attention was also given to the National needs where immediate (short term) effects (i.e. oxygen balance disturbing, microbial pollution, etc.) dominate.

In the identification, description, evaluation and ranking of the municipal hot spots the settlements discharging the pollution load higher than 50,000 p.e. were generally seen as high-priority hot spots but the settlements discharging the pollution load lower than 15,000 p.e. were not taken into account besides a few ones located upstream of sensitive areas.

In estimating of pollution load of municipal hot spots household wastewater, sanitary wastewater from public institutions, trade and restaurants as well as the industrial wastewater discharging (with or without the treatment) in municipal sewage were taken into account. Note that most of medium and small size industries are usually connected to the municipal sewage system.

In cases when the measured data were not available, using of the following criteria assessed the pollution load:

BOD_5	-	60 g/p.e./d;	COD	-	100 g/p.e./d;
Tot. N	-	12 g/p.e./d;	Tot. P	-	3 g/p.e./d;

In assessing the WWTP capacities required, the following was taken into account:

- Previous (before the year 1992) pollution discharge
- The current degree of canalization of settlements;
- The planned enlarging of municipal sewage system
- Long-term trend of physical growth of population due to the general trend of population concentration in the urban centers or owing to the advantages offered by the given settlement,
- Natural population growth (birth rate) trend;

The basic data on a total of 53 municipal hot spots are presented in a tabular form (tables 2.2.-1; 2.2.-2; 2.2.-3) In column (3), in addition to the name of settlement (1) the wastewater recipient (2), the values of minimum mean monthly flows (return period of 20 years) Q_{95}, for given the recipient were shown. In the column 4 the wastewater load based on the population equivalent is given. The currently applied type of treatment (or discharge) is marked in columns 5,6 and 7.

The yearly hydraulic load for each hot spot is given in the column (9) Where it was available given the value represent measured data but where it was not available the volume of wastewater was assessed on the basis of the specific water consumption of 0.2 m^3/p.e. / d.

The yearly loads of BOD_5, total nitrogen, total phosphorus and suspended matters are presented in the columns 10,11,12 and 13 respectively. It has to be point out that because of the large decreasing of industrial production the real pollution load for the period 1994-97 is 45-55% of the values presented in the tables.

In columns 14 and 15 the needed WWTP Capacities and the shortage of the treatment capacity (important for the treatment plants to be enlarged) are given. At last, in column 16, the reasons for WWTP construction proposal are briefly explained.

Summary data for all priority municipal hot spots are given in the table 2.2. As presented, 53 municipal hot spots have been chosen with total pollution emission of about 5,740,000 p.e.

2.2.1. High Priority

The Index of High Priority Municipal Hot Spots is given in Table 2.2.-1. The distribution of these hot spots within the Country is shown on the Map (Fig. 2.-1).

A total 23 of hot spots (pollution load estimated 4,000,000 p.e.) are ranked as high priority ones. The summary information for each high hot spot is given in separate tables.

2.2.2. Medium Priority

The Index of Medium Priority Municipal Hot Spots is given in Table 2.2.-2 (Medium and Low Priority). The distribution of these throughout the Country is shown on the Map (Fig. 2.-1).

A total 24 of hot spots (poll. load estimated 1,595,000 p.e.) are ranked as medium priority ones.

It has to be pointed out that some of the analyzed hot spots of medium priority could be put in the category of hot spots of high priority if local and national approach would prevail in this analysis.

2.2.3. Low Priority

The Index of Low Priority Municipal Hot Spots is given in Table 2.2.-3. The distribution of these hot spots within the Country is shown on the Map (Fig. 2.-1).

Just 6 of hot spots (pollution load estimated 167,000 p.e.) are ranked as low priority hot spots.

2.3. Agricultural Hot Spots

There are around 1,700,000 heads of cattle and beefs, 4,000,000 pigs, 2,000,000 sheeps and around 25,000,000 heads of poultry raising within Danube watershed in FRY. The largest part of its are spread throughout of Country in small private households but smaller part of its are bred in the farms.

A cattle and beef breeding is carried out mostly in the private sector. The larger cattle farms (with more than 500 heads) are exclusively in state or so-called social ownership. In the Danube River basin there are 100 larger cattle farms, each of them breeding 1,000 heads on the average. These farms are less significant as point sources of water pollution as the dry method of farm cleaning and manure disposal is used.

The similar conclusion can be driven analysing the poultry farming but not for the pig farming.

The pig farming is carried out mostly in the private sector but all large co-operative farms (with more than 5,000 porkers per cycle) are exclusively in state or so-called social ownership. There are 130 larger pig farms within the Danube watershed in FRY, with around 1,200,000 porkers bred per year. These farms use to be the main point sources of agricultural pollution within the Yugoslav part of Danube watershed. There are a total of 43 pig farms with the capacity of 10,000 (or more) porkers a year, mostly located in Vojvodina Province. Several large pig farms considered as the priority hot spots are located in Velika Morava Valley and in the Eastern Serbia.

On the farms having the capacity of up to 20,000 porkers a year, the combination of dry and wet method of farm cleaning and manure disposal is used, while on the farms having the capacity of over 20,000 porkers a year, the wet method prevails. Those farms, which use wet method of farm cleaning and manure disposal, are of the top interest concerning Water Pollution Control.

The organic load produced in larger pig farms within the Danube watershed in the FRY amounts more than 2,000,000 p.e. but only a small portion of this load enters surface inland waters. Nevertheless a part of pollution (or by-products originate from pollution) from pig farms penetrates into the ground causing the contamination of groundwater, and indirectly, watercourses or drainage canals. Unfortunately, there are no precise data on the quantities of pig farms pollution reaching ground waters. Note that no direct discharging of wastewater and wastes from pig farms (or any other type of farms) into the rivers and canals exist. It may occur only in accidents (when the lagoons are overloaded or after the heavy rains). Liquid pig farm wastes usually discharge into lagoons or natural low land areas and, after being stored, its are disposed onto agricultural land. Unfortunately, there are several farms using “blind arms” of irrigation canals to dispose its wastes.

Note that just several farms have facilities for the treatment of liquid wastes (anaerobic treatment with biogas production, facultative lagoons, etc.).

Although every large pig farm is respectable source of pollution, the farms located in the vicinity of watercourses, water supply resources, fishpond impoundments or recreational zones, pose a special risk. These farms are seen as Agricultural Hot Spots of the high priority. Several pig farms located not far from recipients are seen as the Agricultural Hot Spots of medium priority.

All other larger pig farms could be marked as the hot spots of low priority.

2.3.1. High Priority

The Index of High Priority Agricultural Hot Spots is given in Table 2.3.-1 (High Priority). The distribution of these throughout the Country is shown on the Map (Fig. 2.-2). Among 13 pig farms marked as hot spots, 6 are ranked as high priority ones.

2.3.2. Medium Priority

The Index of Medium Priority Agricultural Hot Spots is given in Table 2.3.-1 (Medium and Low Priority). Among 13 pig farms marked as hot spots, 7 are ranked as medium priority ones. The distribution of these throughout the Country is shown on the Map (Fig. 2.-2).

It has to be pointed out that some of the agricultural hot spots of medium priority could be moved in the category of hot spots of high priority if local approach would prevail in this analysis

2.3.3. Low Priority

There is no need to analyze pig farms as the hot spots of low priority as its are located in the areas far from current or potential water resources as well as from the recipients. These farms usually have enough arable land so the total quantity of wastes produced is used for soil manuring.

2.4. Industrial Hot Spots

The analysis is focused on the several large abandoned industries (wood and paper, food processing, chemical and fertilizers industry), thermo power plants (ash dumpsites) and mining (flotation dumps). The largest part of them is located in the central and southern part of the Country. The relevant data are presented in the table 2.4.-1 as well as on the Map 2.-3.

It has to be pointed out that the pollution load presented in the table 2.4.-1 relates to the conditions of full operation of given industries. It is also important to emphasize that each industry has some kind of simple structure (storage, retention basin, lagoon, etc.) for wastewater disposal so a part of pollution (particularly suspended solids) is removed before discharging of overflow into recipients. Besides the permanent discharge of pollution load remained, the risk of accidental pollution in above mentioned structures is high because of the burden of pollution stored in its.

It is not easy to estimate the costs of the construction of WWTP (or other suitable technical measures) in this moment because of uncertain fate of industries involved in this analyse. The programes of water pollution reduction for this category of polluters ought to be set flexibly due to the uncertainty regarding the fate of a number of industrial capacities, the real needs of restructuring of existing industrial capacities and introduction of new advanced (environment friendly) technologies instead of old ones. The reaching of this goal would give a great benefit in protection of environment as well as a significant decreasing of the investment cost for the construction of Wastewater Treatment Plants.

2.4.1. High Priority

The Index of High Priority Industrial Hot Spots is given in Table 2.4.-1.). Among 15 industries marked as hot spots, 7 are ranked as high priority ones. The distribution of these hot spots throughout the Country is shown on the Map (Fig. 2.-3).

2.4.2. Medium Priority

The Index of Medium Priority Industrial Hot Spots is given in Table 2.4.-1. Among 15 industries marked as hot spots, 8 are ranked as medium priority ones. The distribution of these throughout the Country is shown on the Map (Fig. 2.-3).

2.4.3. Low Priority

Low Priority Industrial Hot Spots are not analyzed as its are significant just on the national level.

3. Identification of Diffuse Sources of Agricultural Pollution

3.1. Land Under Cultivation

There are 63,190 km^2 of so-called agricultural land (i.e. arable land, orchards, vineyards, pastures, meadows, and wetlands) or 61.84% of total territory of FRY (see Fig. 3-1). Around 53.4 % of agricultural land leis in hilly-mountainous region but the rest of 46.6 % lies at lowland. The largest part of it (83% of total) is private property.

For some kind of agricultural production 4,902,000 ha of the agricultural land is used.

There is 55,587 km^2 of agricultural land within Danube River Basin in FRY, of what 37,560 km^2 is arable land. As for information, the forests cover 25,210 km^2, the pastures and meadows 17,280 km^2, of DRB in FRY.

The average total biomass production within the Danube Watershed in FRY amounts 21,000,000 t/y. The structure of the production is given in the table as follows:

Sort of Agriculture	Total Production (000 t/y)
Crops	9,600
Fodder Crops	2,800
Vegetable Plants	1,550
Industrial Plants	5,450
Fruits & Grapes	1,500

The consumption of fertilizers

The specific consumption of mineral fertilizers within the territory of FRY was 250-285 kg/ha/y during the period 1981-1988. After the year 1988 it was severely decreasing so during the period 1994-1997 it felt down below 100 kg/ha/y. The ratio of active components in artificial fertilizers used are as follows; N – 55%, P_2O_5 – 23.5%, K_2O – 21.5%.

Besides the mineral fertilizers the animal manure is widely used for soil fertilizing. The specific consumption (by active components) is comparable with the one of artificial fertilizers.

The following table shows the consumption of the active components;

	N (kg/ha/y)	P_2O_5 (kg/ha/y)	P (kg/ha/y)	K_2O (kg/ha/y)	K (kg/ha/y)
Artificial fertilizers	52	25	11	22	18.2
Animal manure	25	15	6.5	31	25.7
Total	77	40	17.5	53	43.9

It is estimated that the average plant uptake of N and P in general overcomes impute of nutrients by fertilizers so the largest part of arable land under cultivation is not eutrophicated.

It is to be pointing out that the most intensive use of artificial fertilizers is practised at lowland where vertical component of nutrients transport prevails. The largest part of nitrogen in excess is transformed (or loss) but the phosphorous is adsorbed by unsaturated soil.

It is estimated that the average area specific nitrogen export for the FRY is in the range of 0.1-0.15 $tN/km^2/y$ and phosphorous in the range of 0.015-0.025 $tP/km^2/y$.

The consumption of Pesticides

The specific consumption of pesticides within the territory of FRY was the largest (3 kg/ha/y) during the period 1983-1985. Than it was rapidly decreasing so during the period 1994-1997 it felt down to 1 kg/ha/y. The concentrations of pesticides in excess are not observed in routine water quality monitoring. In according with the data of Federal Health Institute, the contamination of drinking water by pesticides was not observed.

Erosion and Land Loss

Total average production of deposits in the Danube River Basin on the territory of FRY makes about 35-40 million m^3/y. The erosion appears on 86% (about 77,000 km^2) of total DRB in FRY.

The fluvial erosion is the dominating one, however, in the northern part (agricultural area) of the Country there is a significant wind caused (eolic) erosion. The excessive erosion appears on only 4-5% of the total territory (see Fig.3-1), whereas a weak erosion is predominant on 48% of the territory, especially in Vojvodina Province and Posavina Region (Sava River riparian area). The erosion rate ranges between 0,25-0,50 m^3/km^2, and on the average it is 0,45 m^3/km^2. In lowland areas with the most intensive agricultural production the erosion rates are the smallest ranging from 0,25 - 0,275 m^3/km^2.

3.2. Grazing Areas

There are 1,361,000 ha of pastures within Danube River Basin in FRY suitable for grazing. The largest grazing areas lie in hilly-mountainous regions at the south-west and south-east of the Country. There is also quiet a number of smaller regions throughout the Country, which have been using for grazing.

As estimated, there are 1,000,000 heads of cattle and beef and 1,200,000 sheep grazing on the pastures in hilly-mountainous regions.

The largest part of pastures is used for extensive grazing but just 20% of total area of pastures are used for intensive one.

It has to be pointing out that the practice of artificial fertilizing of pastures, even in areas of intensive grazing, have not been practised.

There is no evidence on the export of nutrients from grazing areas but concerning the data on water quality of streams receiving runoff from these regions, it can be concluded that the nutrient export is not high (comparable with the natural one).

4. Updating and Validation of Water Quality Data

The transboundary issue of ambient water quality monitoring in Yugoslav part of Danube River Basin is a very complex one as 21 rivers (Danube, Sava, Tisza, Drina, Bajski canal, Plazovic, Keres, Zlatica, Bega Old, Bega Canal, Timis, Karas, Rojga, Moravica, Brzava, Nera, Nisava, Jerma, Gaberska river, Studva, Bosut) flow in FRY and 6 rivers (Timok, Piva, Tara, Cehotina, Lim, Rzav) flow out from FRY. In addition, several rivers empty into Danube (e.g. Drava, Vuka, Cerna, etc.) along the stretches where it makes State border.

As it is pointed out above in the text, FR Yugoslavia was not included in DRB Pollution Reduction Programme up to the end of 1997. As the consequence there is not ambient water quality data for the previous period to be updated. Also, due to the political reasons the co-operation with neighboring countries have been decreased (or interrupted). As the consequence, the data on water quality of Danube River are not fully valid ones because the samples along the sections make the Border were taken just at the Yugoslav side of the river.

Ambient Water Quality Data have been generating trough routine monitoring of surface inland water and ground water quality. That was done by the State Institutions (i.e. Republican Institutes of Hydrometheorology). As this activity is directly supported by Government budget, the budgetary limitations had the large influence on the monitoring of water quality.

In spite of the troubles, the ambient WQ monitoring have been continuously doing but less intensive than it was previously.

Analyzing the available data on water quality it can be registered a slight improvement of river water quality (unfortunately there is no evidence on river sediments quality) during the period 1994-97 comparing with one from the period before 1992. Bearing on mind that there was not a serious actions in Water Pollution Control within the Danube River Basin that slight improvement of ambient water quality could be explained by significant decreasing of industrial and agricultural production in upstream (particularly neighboring) Danube countries as well as in FR Yugoslavia. Nevertheless, the water quality of the largest international rivers as well as water quality of largest part of national rivers is far from being satisfactory. It is particularly truth for the river stretches downstream of the settlements as the largest part of wastewater are discharged into recipients without any treatment.

4.1. Index of Water Quality Monitoring Records

In order to give better insight of the position of FRY within the Danube River Basin the map on the figure 4-1 is given in Annex.

The hydrological monitoring network of FRY (Figure 4-2) for the periodic or permanent monitoring of the regime of surface and ground waters as well as for water quality, comprises 398 gauging stations for the monitoring and measurement of water level, flow, water temperature, suspended solids and the occurrence of ice. Around 40% of its are also used for water quality measurements (physical, chemical and biological parameters) with the monitoring frequency 4-12 times a year.

Of the above mentioned stations, 63 are so-called hydrological reporting stations. The data from 20 so – called hydrological reporting stations are transmitted for international exchange.

On the map (Fig. 4-2) showing the network of surface-water hydrological stations in the FRY, the stations for the measurement of water level, water flow, sediment discharges, water temperature, as well as the stations equipped for permanent record of water level are all designated with special markings. The coordinates as well as some basic data for the relevant hydrological stations within the Danube Basin in FRY are presented in the table 4.1.-1

On the rivers within the Danube river basin there are 157 gauging stations where both (but not simultaneously), the measurement of flow and water quality are carried out on the regular base. Among these stations, a total of 62 are selected (see table 4.12-1) for the analyzis and presentation of water quality relevant to this Review. The inex of water quality monitoring station relevant for this Review is given in the table 4.1.-2.

4.2. Data Quality Control and Quality Assurance

The quality of data on ambient water quality depends on many factors; education, conscientious and skills of personal, lab equipment available, procurement of good quality lab stuff, chemicals, standards, etc., methodologies and methods in lab examinations used, quality of sampling equipment and accessories, sampling procedures and conscientious of sampling personal, etc. All this has to be certainly supported by finance. Many of above mentioned preconditions were not satisfied (i.e. equipment, procurement of good quality lab chemicals, standards, sampling equipment and accessories) during the analyzed period 1994-1997 so it had influenced the reliability of data.

Additional problem has been created by excluding of FRY from international programmes which give good opportunities for cooperation, exchanging of knowledge and information, comparison with others, support from international funds, etc. All above mentioned, combined by lack of finance from national sources had the strong influence on the quality of work on water quality monitoring as well as on the quality of data produced in spite of the efforts of personal to retain previously reached level of quality of work.

There is internal quality control and quality assurance in the laboratories of Institutes of Hydrometheorology which are responsible for ambient water quality monitoring. It is done by using of internal standards, spikes and “blind” samples. There isn’t external quality control and quality assurance neither on the national level (secondary standards are not available in National Bureau of Standards and Measures) nor on the international level (FRY is not included in interlaboratory calibration programmes). Bearing all above mentioned on mind, the quality control and quality assurance within the laboratories responsible for ambient WQ monitoring can be marked as medium.

4.3. Data Consistency, Compatibility and Transparency

Data are consistent concerning methodology and methods used because they are regulated and standardized. Therefore, all the data are produced by the same methodology (sampling, separation of liquid and solid part of sample, conserving of samples, etc.) and methods (lab determinations) so its are consistent concerning this part of the process of generating of data. Data are not fully compatible in spite of the fact that sampling places are permanent ones. Unfortunately, the principle of “sampling of the same volume of water” along the river is not practiced because of lack of finance for doing that.

On the stretches of Danube river where it makes State Border (FRY – Croatia, FRY – Romania) sampling from several points of river coarse (i.e. left, right bank and middle) could not be done because of the Border regime. It is particularly important for the sections of Danube River downstream of Drava river mouth (i.e GS “Bogojevo”), than along the Iron Gate Reservoirs and upstream of the State Border of Yugoslavia-Romania-Bulgaria (i.e. GS “Radujevac”- GS “Gruja”) where is the mixing zone of wastewater of IHP “Prahovo” Industry (located on the right bank).

Data are presented in the Annual reports on ambient water quality without any compilation or statistical analysis. As its are presented as the row data its are transparent.

Also, its are transparent concerning the publicity as it is regulated by low.

4.4. River Channel Characteristics

The area of 88,919 km^2 e.g. 87% of the total territory of the FRY belongs to the Danube River Basin (Fig. 4-3). About 81,660 km^2 lies in the Republic of Serbia and about 7,260 km^2 lies in the Republic of Montenegro.

The main course of the Danube crossing the FRY is 588 km long, of which about 138 km constitute the State border with Croatia and about 213 km constitute the State border with Romania. Danube River receives its largest tributaries (i.e. Drava,Sava,Tisa) along this part of the main watercourse, so that its flow increases 2.5 times.

Also, several not so large as Sava and Tisa are, but significant tributaries (i.e. Velika Morava, Timis coming from Romania, Timok making a part of the Yugoslav-Bulgarian State border) as well as several smaller ones (Mlava, Pek) empty into Danube along this part of the main watercourse. All these tributaries drain territory of about 360,000 km^2 so the watershed of Danube River along this part of main watercourse increases approximately 2.5 times.

Some relevant hydrological data of the tributaries empty into Danube within the Yugoslav territory are shown in the Table as follows;

River	Catchment area at the mouth (km^2)	Catchment area within FR Yu (%)	Length of main watercourse in FR Yu (km)	Discharge (m^3/s)*	Status of the River
Sava	95 132	32.6	207	1550	international
Tisa (Tisza)	158182	5.7	163	794	international
Velika Morava	38 345	97.2	whole	230	international
Tami{ (Timis)	10 280	7,3	120	37	international
Mlava	1886	100	whole	12	national
Pek	1233	100	whole	9	national
Timok	4215	93.5	**	31	international

* *Average perennial discharge at the mouth*
** *About 19 km of the lowest part of watercourse makes the Yugoslav-Bulgarian State border*

It should be noted that the Drava river (Q_{av} -571 m^3/s), also the large tributary, empties into the Danube on the part of its course which constitutes the Yugoslav-Croatian State border, but the estuary of this river is in the territory of Croatia. Also, some of the tributaries which, in the territory of the FRY, empty into the Sava river (e.g. Drina river, Q_{av} -371 m^3/s), into the Tisa river (e.g. Bega Canal, Qav-29 m^3/s) as well as into Velika Morava river (e.g. Nišava river, Q_{av} -24 m^3/s) are all international rivers.

Bearing on mind the above mentioned, it can be rightfully concluded that the hydrological “navel” of the Danube is sited along the part of main watercourse crossing the territory of the FRY.

In order to provide a better insight into the complex hydrological situation within this part of the Danube, as well as to provide better understanding of cross section analysis given further within this text, some characteristic points on the main Danube watercourse are shown in the table as follows.

Dunav (Danube) River:

Important point	River km	Remark
The entrance in FR Yugoslavia	1433	State border with Hungary & Croatia
HS “Bezdan”	1425.5	the first gaug. stat. downstr. of State border
Impoundment “Bezdan”	1425	the beginning of DTD Canal (upper arm)
Drava River mouth	1383	right bank, mouth at Croatian territory
Impoundment “Bogojevo”	1364	the beginning of DTD Canal (lower arm)
Vuka River mouth	1333	right bank, mouth at Croatian territory
The end of border with Croatia	1295	length of reach shared 138 km
Mouth of Canal Novi Sad - S.Selo	1253	left bank, City of Novi Sad
Tisa River mouth	1215	left bank, International River
Sava River mouth	1170	right bank, Internat. River, City of Belgarde
Timis River mouth	1155	left bank, river coming from Romania
Velika Morava River	1105	right bank, 97.5% of watershed
FRY Mlava River mouth	1090	right bank, national river
DTD Canal mouth	1076	left bank, inetrsects rivers from Romania
Nera River mouth	1075	left bank, the beginning of Yu–Ro border
Pek River mouth	1058	right bank, national river
“Iron Gate I” Dam	943	power generat., navigation, Yu &Ro share
“Iron Gate II” Dam	863	power generat., navigation, Yu&Ro share
Timok River mouth	845	state border with Bulgaria (19 km)
The end of State border with Romania	845	length of reach shared 213 km

As it is mentioned above, the complex international issue can also be seen on the large tributaries empty into Danube in FRY. In order to provide a better insight and better understanding of at whole issue, the characteristic points on the main tributaries of the Danube (e.g. Sava and Tisa), otherwise international rivers, are given in the tables as follows;

Sava River:

Important point	River km	Remark
The entrance in FR Yugoslavia	207	State border with Bosnia & Hercegovina (Srpska Republic) and Croatia
Drina River mouth	174	right bank, the end of border by Bosnia & Hercegovina (Drina River constitutes about 180 km of State border)
Kolubara River mouth	27	right bank, national river

Length of Sava river watercourse trough the territory of FR Yugoslavia - 207 km

Length of reach shared with Bosnia & Hercegovina (Srpska Republic) - 33 km

Tisa (Tisza) River:

Important point	River km	Remark
The entrance in FRY territory	163	State border with Hungary, length of reach shared - 3 km
HS “Martonos”	159	the first gauging station downstream of State border
Inlet of DTD Canal	73	right bank
Impoundment “Padej”	105	the beginning of Kikindski Canal
Impoundment “Novi Be~ej”	65	the extension of DTD Canal
“Be~ej” Gate	63.5	Gate for irrigation and navigation purposes
Begej (Bega) River mouth	10	left bank, river coming from Romania

Length of Tisa River watercourse trough territory of FR Yugoslavia - 163 km

Length of reach shared with Hungary - 3 km

4.4.1. Network

In order to provide a better insight in the Danube watershed within FRY as well as the insight in the hydrological network, the map (Figure 4-3) showing sub-watersheds is given in Annexe.

The length of all permanent watercourses within FRY is 72,858 km so the average density of the river network is 713 $m/km^{2.}$. Although the average density of river network is rather high, its territorial distribution is uneven and ranges from 75 m/km^2 in the flat north part of the Country (Vojvodina Province) to 3,500 m/km^2 in the south-western, mountainous part of the Country.

Although the density of the natural river network in Vojvodina Province is low, this part of the FRY is intersected by numerous canals (the total length of canals is about 100,000 km), whose “back-bone” is the Danube-Tisa-Danube (DTD) Main Canal. This large, 250 km long, navigable canal, begins at Bezdan (Danube river km 1425), where the upper water intake is located, then intersects the Tisa river upstream from the Bečej Gate (Tisa river km 63.5) and ends near Banatska Palanka (Danube river km 1076), just one km upstream from the State border with the Romania.

Instead of network diagram in the graphical form, the relevant data on the area of watershed, as well as data on discharges at characteristic points, are shown at the table as follows:

Location	River km	Watershed (km^2)	Discharge* (m^3/s)	Remark
State border	1433			
GS Bezdan	1425.5	210 250	2280	
GS Bogojevo	1367	251 533	2760	**Drava** river mouth at river km 1381
GS Slankamen	1215	411 961	3585	**Tisa** river mouth at river km 1215
GS Pan~evo	1149	525 009	5200	**Sava** river mouth at river km 1170 **Tamis** river mouth at riv. km 1155
GS V.Gradi{te	1059	570 375	5500	**Velika Morava** river mouth at river km 1105
State border	845	~ 585 000	~ 5670	**Timok** river mouth at river km 845

** Average perennial discharge*

The data presented in the table can be used for making the network diagram in graphical form.

4.4.2. Channel Cross Sections

Within the EU/AR/303/91 project “Danube Basin Alarm Model”, the Federal Institute of Hidrometheorology has, in co-operation with the Republic of Serbia Institute of Hidrometheorology and the Faculty of Civil Engineering of Belgrade University, made an analysis of the characteristics of the main course of the Danube through the FRY. These data are presented in further text in an abbreviated form. In accordance with the hydraulic and hydrologic conditions prevailing in specified parts (see Fig. 4.4.2.-1) of the Danube river watershed, the main course has been divided into two parts:

- *the first, more upstream part* (e.g. from the Yugoslav State border - river km 1433.0, up to the Belgrade - river km 1170.0), where the natural flow regime prevails during most of the year,

  and
- *the second, downstream part* (e.g. from Belgrade to the State border at the mouth of Timok - river km 845) where the backwater effect of the Iron Gate Dams exists.

The first part was further divided into 5 sections, two of which have two subsections each, as shown in the table as follows:

N°	Mark of Reach/Section (see Fig. 4.4.2.-1)	Length (km)	Control point	Control point at river km
1	D - 1-1	16	HS Bezdan	1425.5
2	D - 1-2	36	HS Apatin	1401.5
3	D – 2	49	HS Bogojevo	1367.0
4	D – 3	52	HS Ba~ka Palanka**	1301.5
5	D - 4-1	47	HS Novi Sad	1255.5
6	D - 4-2	20	HS Slankamen	1215.5
7	D - 5	45	HS Zemun	1174.0

*** Name of station in international network is Ilok (right bank at territory of Croatia)*

The basic hydraulic data for this stretch of Danube River are shown in the tables 4.4.2.-1; 4.4.2.-2; 4.4.2.-3; 4.4.2.-4; 4.4.2.-5; 4.4.2.-6 and 4.4.2.-7 (see Annexes).

The second part of Danube main watercourse was further divided into 11 sections as shown in the table as follows:

N°	Name of section	Section mark (see Fig. 4.4.2.-1)	Upstream node at river km	Downstream node at river km	Length of section (km)
1	Pan~evo	D - 6-1	1170.0	1149.30	20.70
2	Morava	D - 6-2	1149.0	1105.50	43.50
3	Nera	D - 6-3	1105.0	1075.50	29.50
4	Golubac	D - 6-4	1075.0	1043.50	31.50
5	Dobra	D - 6-5	1043.0	1017.20	25.80
6	Milanovac	D - 6-6	1017.0	990.50	26.50
7	Dam I	D - 6-7	990.0	944.25	45.75
8	Kladovo	D - 6-8	944.0	933.50	10.50
9	Milutinovac	D - 6-9	933.0	900.50	33.50
10	Dam II	D - 6-10	900.0	863.50	36.50
11	Timok	D - 6-11	863.0	845.80	17.20

The relation: cross section area versus altitude (water level) for several relevant profiles along this stretch of Danube River are shown at Figures; 4.4.2.-2; 4.4.2.-3; 4.4.2.-4; 4.4.2.-5; 4.4.2.-6 and 4.4.2.-7. Also, the data on flow and average section velocity for the sections D-6-1 to D-6-11 are given at the table 4.4.2.-8.

The relevant hydraulic data for the rivers Sava and Tisa are given in the tables 4.4.2.-9 to 4.4.2.-15.

As it is mentioned above, Water Regime along the downstream part of Danube course in FRY is under the influence of backwater effect of the Iron Gate I Dam that is built under the joint project of Yugoslavia and Romania. Besides the generation of electricity the construction of the Dam was greatly improved the navigation.

The Dam (put in operation at 1973) has been constructed to operate at a maximum water level of 69.5 m. above sea level. However, the maximum water level at which the dam has been operated during the first few years was kept at the level of 68.00 m in order to evaluate and control complex impacts of the reservoir upon the flood plain. The water level at the dam is a function of the water flow at the mouth of river Nera (GS “Banatska Palanaka” - river km 1076+650).

Since the dam and the power station have been constructed the following operating water level regimes have been implemented: 68/63 up to the end of 1977, 69.5/63 from 1977 to 1984 as an experimental regime, and, 69.5 and more since 1984. The basic characteristics of these water regimes are:

Regime 68/63 - For river water flows up to 7350 m^3/s water level at the dam is controlled so that the water level at the mouth of the river Nera is kept constant at 68 m above the sea. For river water flows in excess of 7350 m^3/s the water level at the dam is kept constant at 63 m above the sea and the water level at the mouth of the river Nera is allowed to form naturally.

Regime 69.5/63 - For river water flows up to 10000 m^3/s water level at the dam is controlled so that the water level at the mouth of the river Nera is kept constant at 69.5 m above the sea. For river water flows in excess of 10000 m^3/s the water level at the dam is kept constant at 63 m above the sea and the water level at the mouth of the river Nera is allowed to form naturally.

Regime 69.5 and more - For the first phase which is experimental for river water flows up to 11000 m^3/s water level at the dam is controlled so that the water level at the mouth of the river Nera is kept constant at 69.5 m above the sea. For river water flows in excess of 11000 m^3/s the water level at the dam is kept constant at 63 m above the sea and the water level at the mouth of the river Nera is allowed to form naturally. In the final phase which will be put into operation once experimental phase is completed for river water flows up to 13000 m^3/s water level at the dam is controlled so that the water level at the mouth of river Nera is kept constant at 63.00 m above the sea. For river water flows in excess of 13000 m^3/s water level at the dam is kept constant at 63.00 m above the sea and water level at the mouth of river Nera is allowed to form naturally.

Figure 4.4.3.-1 shows the bed line of the Danube, the longitudinal water level profile for natural conditions as well as for the backwater effect conditions for high river water discharges occurring once in 100 years ($Q_{1\%}$). Also shown are the longitudinal profiles for the water regimes 68/63 and 69.5/63.

For the water regime of 68/63 the reservoir extends up to the mouth of river Nera for all flows in excess of 7350 m^3/s while for flows around 2000 m^3/s the reservoir extends all the way to the mouth of river Tisa. For water regime of 69.5/63 the reservoir extends up to the mouth of river Nera for all flows in excess of 10000 m^3/s while for flows around 2000 m^3/s the reservoir extends all the way to the HS “Novi Sad”- Danube river km 1255.5, up to the HS “[abac”- Sava river km 102.6 and up to the Be~ej Gate-Tisa river km 63.5. The volume of in- stream reservoir changes from 1.5-3.0 billion m^3 depending of water regime.

The modified water flow regime along the reservoir results in a number of other significant changes in the morphology of the river-reservoir channel, transport and sedimentation of particulate matters and sediments, oxygen transfer, phyto-plankton population structure and its dynamics and a series of other physico-chemical characteristics and processes all of which have a profound effect upon the water quality of the river Danube, both upstream and downstream of the Dam.

All above mentioned makes this reach of Danube extremely important as well as interesting to be investigated on the permanent base.

Downstream of the Iron Gate I the next, 85 km long, in stream reservoir (volume around 870 million m^3) is formed by Iron Gate II Dam that is built under the joint project of SFR Yugoslavia and Romania. This Dam (put in operation at 1985) consists of two separate structures: a dam on the main river channel and the overflow dam on the side arm of the Danube on Romanian side of the river. The second overflow is constructed on Yugoslav bank in 1994.

The two Iron Gate power stations operate as one system and the operation of the Iron Gate II plant is controlled by the operation of the Iron Gate I plant. In accordance with the design, the Iron Gate II plant operates at a variable water level (from 39.4 m to 41.0 m). The water levels are controlled so that the water level at Kladovo does not exceed 42.0 m for flows in excess of 10.000 m^3/s and does not exceed a level of 43.6 m at flows in excess of 16 350 m^3/s. The backwater effect of the Iron Gate II Dam is therefore felt all the way to the Iron Gate I dam.

4.4.3. Gradients

Gradients (slopes of water level) between the hydrological stations can be calculated on the basis of the data on water levels at given hydrological stations and the length between these stations.

The daily water levels at relevant hydrological stations along the Danube watercourse in FRY are reported every day in 12 o`clock over the Radio Belgrade on Serbian, Russian and Franch language. It could be also found on the Web Site (www.meteo.yu) of Federal Hydrometheorological Institute.

All hydrological data for the Danube river watercourse are published every year in the annual report of Republic Hydrometheorological Institute of Serbia.

Before the construction of the Iron Gate I and Iron Gate II hydro-electric power and navigation system, the hydraulic gradient on both, the Yugoslav and Yugoslav-Romanian sections of the Danube, was about 0.05 $^{o}/_{oo}$ in average, on the section from Bezdan to the entrance into the Djerdap Gorge (river km 974), while in the gorge itself it was even over 0.3 $^{o}/_{oo}$. A graphical presentation of the change in the hydraulic gradient along the course of the Danube prior to the construction of the Djerdap (Iron Gate) Hydro-electric Power and Navigation System is shown in Figure 4.4.3.-1.

After the construction of the Iron Gate I and Iron Gate II system, when the backwater extends to the HS "Novi Sad" at some specific conditions, the gradient became a variable depending on the modes of operation of the Iron Gate I Hydro-electric Power Plant as it is shown schematically at Figure 4.4.3.-1.

It should be noted that the information system on the hydrological parameters has been established on the main course of the Danube and on its direct tributaries. At any moment, it can provide the data on the water levels and, thus, on the hydraulic gradient. For a greater number of such hydrological stations on the Danube and its tributaries, the data are exchanged with the Danube countries on a daily basis, as stipulated by the provisions of the Convention on the Navigation Regime on the Danube (the Danube Commission).

4.4.4. Flood Plains

Figure 4-4 shows potentially flooded areas by the flood flow of return period of 100 years.

The potentially flooded areas are located mostly at the territory of the Republic of Serbia, because the rivers within the Danube river basin in the Republic of Montenegro are mostly gorge ones.

The largest potentially flooded areas lie around the rivers; Danube, Sava, Tisa and Velika Morava and, to a smaller extent, in the lower parts of the watercourses of the Drina, Kolubara, West and South Morava and Timok river. The total potentially flooded area is about 16 000 km^2, of which about 12 900 km^2 is lowland in Vojvodina Province. About 80% of potentially flooded area is arable land, but within it there are more than 500 settlements and more than 500 important industrial plants.

Along the Danube and its main tributaries (Sava, Tisa, Velika Morava) there are embankments (Fig. 4-6) for the flood defence (flow of the return period of 100 years). These embankments are mostly placed at relatively small distances from the banks of the natural main bed, so that the inundation area between them is limited. Note that numerous smaller watercourses are not regulated for flood defence yet.

Besides the potentially flooded plains which are defended by the embankments, there are quiet a number of frequently flooded zones (small icelands, bankarms, etc.) which are sited along the reaches where the width between the embankments is larger. These zones so-called inundations, are usually covered by the vegetation so they have potential to retain a part of pollution as well as the nutrients.

The characteristic stretches along the Danube as well as its locations are given in the table as follows:

Name of Location*	River (km)	
	from	to
Apatin	1382	1410
Ba~ko Novo Selo	1306	1316
Susek	1282	1291
Cerevic	1272	1276
Beo~in	1263	1271
Kovilj	1242	1244
Kr~edin	1226	1231
Slankamen	1213	1218
Belegis	1194	1200

Name of Location*	River (km)	
	from	to
Beljarica	1178	1183
Beograd	1170	1172
Pan~evo	1149	1158
Ivanovo	1136	1140
Grocka	1127	1132
Smederevo	1112	1118.5
Dubovac	1098	1100
Ram	1078	1083
Mihajlovac	860	876

** See also Fig. 4-5*

Although the analyses of flooded plains for the flow of 100-years return period have been made in detail, there are still no detailed analyses of flooded plains (i.e. inundations) for the flows having the lower probability of occurrence (the return period of 5, 10, 30, 50 years) which could be of interest for the Danube River Basin Pollution Reduction Programme.

In order to get more information on the role of above mentioned inundations in retention of pollutants as well as of nutrients, serious investigation has to be done.

4.4.5. Wetlands

There are several large wetlands (see Fig. 4-5) sited behind the embankments along the Danube (e.g. Monoštorski Rit, Sige-Kazuk Area, the zone near Apatin town, area upstream of City of Belgrade, a long stretch under the influence of backwater of Iron Gate I, as well as the stretch under the influence of backwater of Iron Gate II.

There are also several significant wetlands along the Sava River (the marsh “Obedska Bara”, an area protected by Ramsar Convention, the marsh “Zasavica”, etc.) as well as along the Tisa River (e.g. near Senta town, near Bečej town.) which has to be fully protected or could be rehabilitated.

Besides above mentioned, there are several wetlands (e.g. Ludoš lake near City of Subotica and the marsh “Carska bara” near City of Zrenjanin, both protected under Ramsar Convention as the bird reserves) within the Danube watershed in FRY. Every of these wetlands is a unique part of Nature to be saved for the future generations.

4.4.6. Erosion and Degradation

The erosion of riverbanks occurs at unprotected sites by the action of runing water in the river curves and by the action of waves generated by wind. The largest bank erosion is noticed at the left bank of Danube just at the mouth of DTD cannel.

When discussing the erosion in general, the total average erosion production within the Danube Basin in FRY reaches about 17 million t/y, but only 20% of this quantity is transported by the rivers. It comes from the balance of average yearly sediment flow (see Fig.4-9) in the river network of the Danube Basin at the territory of FRY. The data are related to the period 1981-90, as for after 1991 the measurements of suspended sediment discharges have been largely reduced.

As estimated, about 80% of total annual sediments load which is transported by the Danube and tributaries enters FRY from foreign territory (Danube- 6,7 million t/y, Tisa- 4,4 million t/y and Sava - 3,0 million t/y). This quantity is almost equal to one that is trapped in the Iron Gate I reservoir.

It is also important to emphasise that during the past 50 years, thanks to anti-erosion works (afforesting, land-reclamation, irrigation of pastures and forests, etc.), constructing of structures for retaining of sediments, etc., the erosion production as well as sediments discharge within the Country has been substantially reduced. As the consequence, the impute of sediments originating from FRY territory in Iron Gate I Reservoir have been reduced for 50%.

4.5. Dams and Reservoirs

There are 60 reservoirs (about 20 of them being larger than 10 million m^3) and about 100 so-called micro reservoirs within the DRB in FRY. The total retention volume of all of its is about 6.5 billion m^3. Several relevant reservoirs could be seen at the Fig. 4 -7.

The largest reservoirs are Iron Gate I and Iron Gate II serving for electric power generation as well as for the improvement of navigation. As it is mentioned above both of its are formed along the sector of the Danube which is shared between the FR of Yugoslavia and Romania.

The existing reservoirs are mostly multy-purpose ones (flow equalising, increasing of low flow, irrigation, power generation, sediments retention, domestic and industrial water supply). The basic data as well as trapping efficiency for sediments (where available) on the existing in-stream reservoirs relevant for this report are given in the table as follows:

Name of Reservoir	River	Location (river km)	Volume (000 m^3)	Purpose	Trapping effic. (%)
Djerdap I (Iron Gate I)	Danube	943	2 550 000	PG, N	80
Djerdap II (Iron Gate II)	Danube	865	868 000	PG, N	35
Tisa-Be~ej	Tisa	63.5	160 000	N, FP, IR	*
Bajina Ba{ta**	Drina		340 000	PG	60
Zvornik**	Drina		89 000	PG	50

* *No trapping of sediments on the annual base. When Gate is partly closed (April to November) trapping efficiency is around 50%*

** *Border with Bosna & Hercegovina (Srpska Republic)*

PG - Power generation ; IR - Irrigation ; FP - Flood protection ; N - Navigation

4.6. Other Major Structures and Encroachments

In the FR of Yugoslavia, there are about 3,550 km of flood-defense embankments (Figure 4-5). The length of embankments along given the river as well as within given the watershed is shown in the table as follows:

River or watershed	Length of embankments (km)
River Danube	414.17
River Tisa	268.99
River Tamis	118.80
Remaining rivers in Vojvodina	367.64
Channels of DTD system	231.00
Mlava and Pek watershed	108.90
Timok watershed	87.88
Sava watershed	771.00
Velika Morava watershed	1,181.96
TOTAL	3,550.34

Besides these embankments, on the rivers of the FR of Yugoslavia there are about 486 km of bank revetments, 32 km of groins and other river regulation structures. On the Danube River itself, there is about 1256 km of bank revetments, on the Sava River about 37 km, on the Tisa River about 45 km and on the Velika Morava River about 78 km.

The dredging

The river sediments (gravel, sand) are dredged for the purposes of construction industry (sand and gravel) and the maintenance of the navigable waterways. The largest quantities are dredged in the area of Belgrade, Novi Sad, Slankamen, the confluence of the Velika Morava and Danube and the confluence of the Drina River and Sava River.

During the period 1977-1997 an average amount of 10 million tons per year was dredged. Approximately 70% of this amount were dredged from Danube, 15% from Tisa River, 10% from Sava River (mouth of Drina River) and 5% from Velika Morava River.

The largest amounts of the river sediments were dredging along the stretch of Danube from river km 1050-1090 as it is shown in the table as follows:

Location (river km)	Dredged volume In average (m^3/ y)
1050 - 1052	2.0 - 2.5
1055 - 1069	3.5 - 4.2
1075 - 1077	1.0 - 1.2
1083 - 1089	1.5 - 2.0
1112 - 1113	0.2 - 0.3
1172 - 1174	0.9 - 1.2
1268 - 1269	0.04 - 0.07
1398 - 1399	0.15 - 0.25
1401 - 1402	0.03 - 0.05

Remark : Most of the dredged section are not permanently used

After the year 1992 amount of sand and gravel dredged has been rapidly decreasing due to decreasing of civil works. An average amount of 6.5-7.5 million m^3/y has been dredged for the period 1994-97.

The dredging of sludge from irrigation channels has been doing for many years on the regular annual base. This sludge is not polluted by heavy metals so it safely disposes on the surrounding soil. An exemption is the sludge of Bega Cannel dredging (approx. 100 000 t/y) near Klek town. This sludge, originating from Romanian territory, is very polluted so especial dumpsites are formed to scavenge it.

4.7. Major Water Transfers

The major water transfers exist on the Danube and Tisa river (see Fig. 4-6) where the largest water impoundments are constructed. Abstracted water is used for irrigation and industrial supply, as well as for the supply of other consumers in the regions Backa and Banat. It is also used in keeping of cannel network waterways navigable for the vessels up to 1000 DWT.

The Danube water is abstracted (by gravity and by pumping) at two locations (Bezdan and Bogojevo) and is conveyed through Backa Region. The upper branch of this cannel ends into the Tisa River, 3 km upstream of Becej Gate and the lower one ends into the Danube River at City of Novi Sad.

The total capacity of the existing intake structures on the Danube amounts to 90 m^3/s (by gravity about 72 m^3/s and by pumping about 18 m^3/s) but the abstraction of water depends on river water level. The total abstraction of water makes 4% of minimal, mean monthly flow of Danube River at impoundment locations. There is the plan to increase the total intake capacity by additional 18 m^3/s.

The water of the Tisa is abstracted by gravity at Padej village (river km 105) and at Novi Becej (immediately upstream of Becej Gate). Gravity water intake is possible owing to the Becej Gate (63.5 river km, which also serves for navigation control along the Tisa river.

The impounded water makes an artificial river (i.e. DTD Main Canal) crossing Banat Region. It intersects all (except Nera river) watercourses coming from Romania. This canal ends near the settlement of Banatska Palanka just one km upstream of Yugoslav-Romanian State border.

In addition to irrigation and industrial supply, water from this cannel has an important role in dilution of heavily polluted rivers (Zlatica, Bega Old, Bega Canal, etc.), which flow from the Romanian territory. Without the dilution of these polluted rivers ecological conditions in Yugoslav part of the Banat Region would be unbearable.

At present, the total intake capacity on the Tisa River amounts to about 40 m^3/s, e.g. 30 % of minimal, mean monthly flow of Tisa River. The capacity of the upper impoundment at Padej is 8 – 12 m^3/s but the lower one located at Novi Becej is 30 m^3/s.

4.8. Preferred Sampling Stations and Data Sets

Among existing 178 water quality monitoring stations a total of 64 are selected for the analysis and presentation of water quality relevant to this Review. The distribution and positions of selected water quality monitoring stations are shown at the Figure 4-7. The selected stations represent boundary cross-sections, river stretches forming State border, stretches located downstream from hot spots and the nearest locations upstream of the river mouths. In the table 4.12.-1 (Annexes) the transboundary stations are labeled by symbols TBS (i.e. the stations most upstream or downstream of the State border) or BS (i.e. the stations on the river stretch constitutes State border).

The values given in the table are compiled from all data on water quality available for the period 1994-97. Series of 40 – 48 observed values are used for statistical analysis.

The simultaneous measurement of water quality parameters and flow have not been practiced at all. The data on flow are use to be computed backward from Q-H curves. At the tables 4.9.-1 to 4.9.-24 the average daily flows for the period 1994-97 are presented.

Responsible for the maintenance of the hydrological network as well as for all the measurements of hydrological and water quality parameters are:

Federal Institute of Hydrometheoriology - Belgrade

Republic of Serbia Institute of Hydrometheoriology - Belgrade

Republic of Montenegro Institute of Hydrometheoriology - Podgorica

4.9. Water Discharges

The Water Budget for the Danube River watershed in FRY based on statistical analysis of the long time series is shown at the Fig. 4-8. In the period 1994-97, systematic measurements of flow on the Danube and its main tributaries i.e. Tisa River, Sava River and Velika Morava River were carried out at the following hydrological (gauging) stations:

Danube:	Bezdan, Bogojevo, Novi Sad;
Sava:	Sremska Mitrovica;
Tisa:	Senta;
Velika Morava:	Ljubičevski most.

The numerical values of mean daily flows for every year of the mentioned period, as well as the characteristic statistical values (maximum, mean, minimum) are given in Tables 4.9.-1 to 4.9.-24 (Annex). On the basis of these values flow fluctuations at the given stations were graphically presented (Figures 4.9.-1 to 4.9.-6) in the form of a hydrograph. They also depict the water flow duration curves for the observed period 1994-97 as well as for the longer periods. The presented duration curves enable a water flow analysis of the observed periods in different flow ranges. The numerical values of these curves are also given in the table 4.9.-25.

4.10. Sediment Disharges

During the period (1994-1997) measurements of suspended sediments discharges were considerably reduced due to the lack of funds for the realisation of the planned activities. Measurements of the bed sediments have not been done at all. A systematic sampling of suspended sediments was carried out at four hydrological stations on the Danube (HS Bezdan) and its tributaries Tisa (HS Senta), Sava (HS), Velika Morava (HS Ljubičevski most).

The mean daily flows of suspended sediments were calculated by multiplying of the mean cross section concentration of suspended mater by the mean water flow for the given day. The data are presented in the tables 4.10.- 1 to 4.10.- 15 (Annexes). In order to give better insight in sediment discharges within the Danube River watershed in FRY, the average perennial sediments discharge flow diagram is given in Fig. 4-9. The data relates to the period 1980-1991.

As it can be seen at the diagram (Fig. 4-9) the amount of about 14 million t/y of suspended solids is brought by the Danube, Tisa, Sava and Drava from other territories, while at the territory of the FR of Yugoslavia about 4 million t/y of suspended solids is produced. Of the total quantity, about 80% (i.e. about 14 million t/y is trapped in the Iron Gate I and Iron Gate II reservoirs.

4.11. Suspended Sediment Concentrations

On the basis of the known water discharges (given in tables 4.9.-1 to 4.9-24) and sediment discharges (given in tables 4.10.-1 to 4.10.-15) the average concentration can easily be calculated using the relation $C_{av} = G/Q$, where Q – water discharge, G – suspended sediments discharge.

4.12. Water Quality Data

Generally speaking, the FRY is a water (and pollution) receiving country. Around 87% of water flowing throughout the Danube Basin at territory of FRY originates from upstream Danube countries but 13% of it is the internal run-off. It is interesting to note that the large part of runoff from Romania enters FRY directly (Zlatica, Bega Old, Bega Canal, Timis, Brzava, Karas, Nera) or indirectly (by Tisa River) although Romania accounts as FRY downstream country following Danube main watercourse.

The water quality of largest rivers crossing FRY highly depends on the Water Pollution Control at upstream Danube countries. In general, no any river enters FRY can be safely used for water supply without the advanced treatment (i.e. ozone - activated carbon). Some of the rivers (i.e. Zlatica, Bega Old, Bega Canal) are heavily polluted so its water can not be used even for irrigation.

It is important to note that not only fresh pollution (e.g. from Szeged, Temisoara, Vinkovci) but also nutrients, resistant organics and heavy metals (dissolved or adsorbed onto sediments) from remote pollution sources enters FRY. It is estimated that each year over 550-600,000 t of BOD_5, about 300-350,000 t of Nitrogen in various forms, about 20-30,000 t of phosphorus and about 14 million tons of sediments enter the territory of the FRY.

Besides of the above mentioned pollution, the large algal biomass (the concentrations of chlorophyll-a over 150 mg/m^3 into Tisa and Danube River have been regularly observed during summer time) generated upstream of FRY is brought by Danube and its tributaries. The decay of this biomass causes additional disturbances of oxygen regime as well as the forming of various by-products in river water that have adverse effects onto aquatic environment and biota. This phenomenon would have to be analysed in the process of validation of Danube Water Quality Model.

Danube River is a large recipient having large dilution as well as self-purification capacity. The national rivers are not large ones so its dilution capacity is small, particularly during low flow conditions (July-October) when discharges are 8-15 times lower than average ones. In spite of its good self-purification capacity (shallow streams, rocky beds, existing of reefs and pools, etc.) the receiving capacity of national rivers is not large. Bearing this on mind, as well as lack of sufficient and efficient wastewater treatment within FRY, it cannot be concluded that ambient running waters quality is good. There are numerous disturbances of running waters quality, particularly downstream of wastewater discharges, but most of its are not properly detected (water quality monitoring stations are not located just immediate downstream of point sources, low frequency of measurement, etc.) by routine monitoring of water quality.

Unfortunately, the monitoring of river sediments quality on the regular base is not established yet, so the effects of pollution cannot be analysed properly. The lack of data on sediments could be the reason of large discrepancies observed between emission estimated and imission measured.

4.12.1. Nitrogen

Statistical data on inorganic nitrogen components (e.g. ammonia, nitrates, and nitrites) for the relevant selected gauging stations are shown in the table 4.12.-1. Data series of 40 – 48 observations are analysed. Data are also analysed for organic nitrogen but it has to be pointed out that there is no statistically relevant data series on this parameter for the largest number of gauging stations because of low frequency of measurements.

In accordance with available data on water quality monitoring and water discharges, about 300-350,000 t/y (on average) of nitrogen in various forms enters the territory of the FRY. As estimated, a mass of 350-420,000 t/y (on average) of nitrogen, flows out downstream of Iron Gate II Dam (river profile about 16 km upstream of the State border).

4.12.2. Phosphorus

Statistical data on total phosphorous and orthophosphates for the relevant selected gauging stations are shown in the table 4.12.-1. Data series of 40 – 48 observations are analysed.

In accordance with available data on water quality monitoring and water discharges, about 20-30,000 t/y (on average) of phosphorus enters the territory of the FRY. As estimated, a mass of 25-35,000 t/y (on average) of phosphorus, flows out downstream of Iron Gate II Dam (river profile about 16 km upstream of the State border). It is roughly estimated that 6-10,000 tP/y being trapped in Iron Gates.

4.12.3. COD

Statistical data on COD for the relevant selected gauging stations are shown in the table 4.12.-1. It has to be noted that the method used for the COD determination is based on $KMnO_4$ oxidation as it was widely practised within the middle and lower Danube Basin countries.

In order to give insight in oxygen related parameters as COD is, let us mention that about 550-600,000 t/y (on average) of BOD_5 enters the territory of the FRY but a mass of 400-480,000 t/y (on average) of BOD_5 flows out downstream of Iron Gate II Dam (river profile about 16 km upstream of the State border). Bearing on mind this data as well as the additional BOD load discharging in FRY, it can be concluded that the large mass of organics (around 300-350,000 t/y of BOD_5) being degraded (or retained) along the Danube River section crossing FRY.

4.12.4. Heavy Metals

Frequency of sampling for heavy metals determination was 4 times a year so available data cannot be used as the base for serious statistical analysis. Nevertheless statistical data based on the 16 observations on given heavy metals concentration are presented in the table 4.12-1.

It has to be point out that non-filtered samples conserved on-site are used for determination on heavy metals. Also, determination on mercury was not fully developed so data produced are not reliable.

It is important to emphasize that about 14 million tons of sediments partly containing adsorbed heavy metals, enters the territory of the FRY but no proper data on the content of heavy metals in suspended solids entering FRY territory.

4.12.5. Oil and Other Hazardous Chemicals

The concentrations of mineral oil and phenols recorded during the period 1994-1997 are shown in the table 4.12.-1. In general, observed concentrations of mineral oil have not been above the proposed limits but it has to be emphasized that the frequency of measurements was low to provide proper and reliable detection of the content of oil and hazardous chemicals.

Regarding to the oil discharge it is important to note that both Yugoslav refineries have the waste treatment plants operating properly.

Therefore, there were a several accidental oil spills on the Sava River (from the territory of Bosna & Herzegovina, 1986, 1987) the Tisa River (1992) as well as on the Danube River (accidents of foreign tankers 1987, 1997) in the past. Also, there is the evidence on the discharge of used oil from boats in transit.

Bearing all this on mind it could be supposed that the oil found in the Iron Gate I sediments (Cousteau expedition, 1992) do not originate just from the sources located on the Yugoslav territory but also from other sources (upstream countries, foreign tankers and boats navigating along Danube, etc.)

For the evidence of origin of mineral oil spills into the Danube River (water and sediments) it is very important the Danube Basin Alarm System as well as the record of oil spills to be well developed.

4.12.6. Special Linkages

It is not possible to make linkages of concentration of some specific substances with its quantity sold on the market during the analysed period.

Also, there were not proper researches to investigate linkages between heavy storms and non-point sources, or fertilisers sold and N and P concentration in rivers, or air pollution and water quality.

There were some researches done on establishing of linkage between land use and export of nitrogen and phosphorous in hilly-mountainous regions. The total nitrogen and phosphorous export was found to be 0.1 – 0.15 tN/km^2 /y and 0.015 - 0.025 tP/km^2 /y respectively.

In general, soil within the Danube watershed in FRY is not saturated with Phosphorous and Nitrogen because of low rate of fertilisers consumption for a long period.

It is important to point out the good linkage of some seasonal activities and water quality. For example, every year in the summer time, when pumping of water from irrigation canals upstream of the FRY state border begins, hundred tons of aquatic duck-weeds (e.g. lemna) float along Tisa River reaching also Danube River. The 1/4 to 1/3 of water table is usually covered by floating weeds disturbing oxygen transfer and light penetration in water. There is no proper evidence about the fate of this large quantity of organic matters but it is clear that the largest part of it is biodegraded disturbing oxygen regime as well as increasing nutrient content in water body.

Among numerous water quality disturbances it is to be point out that every year (late in November) the gates along Bega Canal have to be put down because of ice season and spring high flow periods. During 3-4 days (the lasting of operation) hundred tons of accumulated heavily polluted anaerobic sediments from Romanian territory enter Yugoslav territory flowing about 100 km to the mouth of Tisa River than to Danube River, finally be trapped in the Iron Gate reservoir.

In the past, farm liquid wastes from Romanian part of Tamiš river watershed were often discharged into the river (or its tributaries) causing heavy damages of river ecosystem (fish kills, etc.) as well as fish kills into the fishponds using river water for supplying. In the period 1994-97 the occurrence of such accidents was much less frequent but still observed.

5. Brief Overview of Legal and Institutional Framework for Water Quality Control

In FRY, the legislation on measurements and water quality control is fairly developed. There is a large number of by-laws (statutes, regulations, instructions, standards etc.) regulating this issue. The competencies within the governmental infrastructure and other participants in this field are regulated as well. Nevertheless, there is the need to renovate the legislative for water quality control and to harmonize it in accordance with requirements of international cooperation.

The basic legal regulations, which stipulate by-laws related to the issues of measurement and water quality control, are as follows:

Federal Level:

- Decree on the Classification of Waters of the Inter-Republic Watercourses, Inter-State Waters and Coastal Sea Waters (Federal Government Gazette, No. 6/78);
- Regulation on the Classification and Categorisation of Ground-Water Reserves and Relevant Recording Keeping (Federal Government Gazette, No. 34/79);
- The instructions for the procedures and modes of water quality monitoring within the Yugoslav network of hydrological stations (Federal Government Gazette No. 72/93)
- **Law on the Fundaments of Environmental Protection** (Federal Government Gazette, No. 24/98);
- Regulations on the Sampling Method and Methods of Laboratory Drinking Water Analysis (Federal Government Gazette, No. 55/78 and 55/85);
- **Low on Water Regime** (Federal Government Gazette No. 59/98)
- **Low on Standardisation** (Federal Government Gazette, No. 30/96);
- Regulations on the Yugoslav Standards (JUS) for Water to be used in Analytical Laboratory Determination – JUS ISO 3696 (Federal Government Gazette, No. 54/94);
- Regulations on the JUS for Testing of Industrial Waste Waters – JUS ISO 3696 (Federal Government Gazette, No. 19/88);
- Regulations on the JUS for Testing of Industrial Waste Waters – JUS H.31.111; JUS H.31.117; JUS H.31.145; JUS H.31.149; JUS H.31.152; JUS H.31.160; JUS H.31.195; JUS H.31.196 (Federal Government Gazette, No. 84/97, 12/82);
- Regulations on the JUS for Testing of Industrial Waste Waters – JUS H 31.113; JUS H. 31.136; JUS H 31.137; JUS H. 31.165; JUS H.31.173; JUS H. 31.175 (Federal Government Gazette, No. 48/85);
- Regulations on the JUS for Testing of Industrial Waste Waters – JUS.H.31.135; JUS H.31.177; JUS H.31.178; JUS H.31.179; JUS H.31.180; JUS H.31.181 (Federal Government Gazette, No. 47/85);
- Regulations on the JUS for Testing of Industrial Waste Waters – JUS H.31.114; JUS.H.31.115; JUS.H.31.138; JUS H.31.139; JUS H.31.140; JUS H.31.141; JUS H.31.142; JUS H.31.144; JUS H.31.163; JUS H.31.190 (Federal Government Gazette, No. 47/85);
- Regulations on the JUS for Testing of Industrial Waste Waters – JUS H.31.100; JUS H.31.101; JUS H.31.102; JUS H.31.103; JUS H.31.104; JUS H.31.170; JUS H.31.171 (Federal Government Gazette, No. 55/83);
- Regulations on the JUS for Water Quality – JUS ISO 5813; JUS ISO 5814; JUS ISO 5815; JUS ISO 6060; JUS ISO 7890-1; JUS ISO 7890-2; JUS ISO 8245; JUS ISO 8466-1 (Federal Government Gazette, No. 56/84);

- Regulations on the JUS for Water Quality – JUS ISO 5664; JUS ISO 6595; JUS ISO 6778; JUS ISO 7150-1; JUS ISO 7150-2 (Federal Government Gazette, No. 56/84);
- Regulations on the JUS for Water Flow Measurement in Open Courses – JUS U.C5.080; JUS U.C5.090; JUS U.C5.092; JUS U.C5.094 (Federal Government Gazette, No. 54/94);
- Regulations on the JUS for Waste Waters – JUS H.31.200; JUS H.31.201 (Federal Government Gazette, No. 1/92);
- **Law on the Protection Against Ionizing Radiation** (Federal Government Gazette, No. 46/90);
- Decree on Maximum Concentrations of Radionuclides and Hazardous Matter in Inter-Republic Watercourses, Inter-State Waters and Waters of the Coastal Sea of Yugoslavia (Federal Government Gazette, No. 8/78);
- Regulations on the Sites and Time Intervals of Systematic Testing of the Content of Radionuclides in the Environment, Early Detection and Reporting on Radioactive Contamination of the Environment (Federal Government Gazette, No. 84/91);
- **Law on Hydrometeorological Affairs of National Concern** (Federal Government Gazette, No. 18/88, 63/90)
- Decision on the establishing of Yu standards for the environmental protection (Fed. Government Gazette No. 11/98)
- Decree on Drinking Water Standards **(**Federal Government Gazette No. 41/98)

Regulations of the Republic of Serbia:

- **Law on Waters** (Republic of Serbia Government Gazette, No. 46/91, 53/93, 48/94, 54/96)
- Decree on Water Classification (Republic of Serbia Government Gazette, No. 5/68);
- Decree on the Categorisation of Watercourses (Republic of Serbia Gov. Gazette, No. 5/68);
- Regulations on the Contents of Technical Documentation to be submitted in the Procedure for Obtaining Water Management Consent and the Water Management Licence (Republic of Serbia Government Gazette, No. 3/78);
- Regulations on MPL of Hazardous Matters in Waters (Republic of Serbia Gov. Gaz., No. 31/82);
- Regulations on the method and minimum number of waste water quality examination (Republic of Serbia Government Gazette, No. 47/83, 13/84);
- Regulations on the Conditions to be satisfied by enterprises and other legal entities carrying out specific examinations on surface and ground water quality as well as on waste water examination (Republic of Serbia Government Gazette, No. 41/94, 47/94);
- Regulations on the method and procedure for determining the degree of purification of discharged waste water (Republic of Serbia Government Gazette, No. 9/67);
- Law on the Use and Protection of Water Supply Sources (Republic of Serbia Government Gazette, No. 27/77, 29/88);
- **Low on Agricultural Land** (Republic of Serbia Government Gazette, No. 49/92, 53/93, 67/93)
- Regulations on the MPL of hazardous and toxic matter in soil and irrigation water and the methods of their examination (Republic of Serbia Government Gazette, No. 23/94);
- **Low on the Environment Protection** (Republic of Serbia Government Gazette No. 65/91)
- Decree on the Assessment of Impacts on the Environment (Republic of Serbia Government Gazette No. 41/93);

Regulations of the Republic of Crna Gora (Montenegro)

- **Law on Waters** (Republic of Crna Gora Government Gazette, No. 6/95);
- Decree on Water Classification and Categorization (Republic of Crna Gora Government Gazette Government Gazette, No. 14/96);
- Regulations on the Contents and Methods of Keeping the Water Register and the Register of Surface and Ground Waters, Consumers and Pollutants, Torrents and Erosion-prone Regions and Water Structures and Plants (Republic of Crna Gora Government Gazette, Nos. 5/96 and 19/96);
- Decision on the Criteria, Amount and Mode of Payment of Compensation for Water Protection Against Pollution, Compensation for Material Extracted from the Watercourse and Compensation for the Utilization of Water Structures (Republic of Crna Gora Government Gazette, No. 15/96);
- Program of Systematic Testing of the Quantity and Quality of Surface and Ground Waters for 1996 (Republic of Crna Gora Government Gazette, No. 30/96);
- Program of Systematic Testing of Water Quality of Water at Water Structures (Sanitary Protection Zones) and Public Bathing-Places (Republic of Crna Gora Gov. Gazette, No. 22/96);
- Regulations on the wastewater quality and the manner of its discharge in sewage systems and recipients (Republic of Crna Gora Government Gazette, No. 10/97);
- **Law on the Environment** (Republic of Crna Gora Government Gazette, No. 12/96);
- Decree on the Assessment of Impacts on the Environment (Republic of Crna Gora Government Gazette, No. 14/97);

The monitoring of quality of water directly related to the public health (drinking water, water resources used for the production of drinking water, water in recreation zones) is under jurisdiction of the Federal and Republic Ministries responsible for Health.

Measurements, processing, publishing and distribution of data on drinking water is responsibility of Republic Institutions for Health, i.e., of specialized regional laboratories of these Institutions.

The data on drinking water quality are published in bulletins on the local and regional level, whereas the Republic Ministries submit separate annual (or more frequent when needed) reports to the Governments.

The Federal Ministry for Labor, Health and Social Affairs, i.e., the Federal Health Institute, each year submits to the World Health Organization the report on the drinking water quality within the territory of the FRY.

The Monitoring of ambient water quality (except of water impounding for the production of drinking water or water along the river stretches assigned for recreation) falls within the competence Republic of Serbia Institute of Hydrometheorology (RHMZS) and Republic of Montenegro Institute of Hydrometheorology (RHMZCG). The Federal Hydrometheorological Institute (SHMZ) is in charge of international issue, whereas RHMZS as well as RHMZCG, which perform measurements at hydrologic stations, have competencies on the territory of each respective republic.

The results of measurements done during the current year are published in the following year by the Republic Institutes of Hydrometheorology in separate publications (Hydrologic Annuals) which are presented to the responsible government, as well as to the relevant institutions and agencies (Public Water Authorities, Water Management Companies, Research Institutes, etc.). All data are open to the publicity, and its are available to any individual upon personal request.

The irrigation water is under competence of the Republic Ministries of Agriculture, Forestry and Water Management. The control of water quality in irrigation canals is performed by specialized laboratories which use to make separate contracts with the Ministries, Water Authorities or Water Management Companies delivering water for this purpose.

Licensed laboratories perform the official measurements of wastewater and effluents from the wastewater treatment plants. The Republican Ministries of Agriculture, Forestry and Water Management, are in charge to issue the licenses according with the proposed procedure.

The legislative regulates the Quality Standards for the following: drinking water (including bottled water) which is also used by food processing industry, water using for irrigation and ambient waters.

The Criteria and Standards for drinking water are fully coordinated with the European Union ones.

The Criteria and Standards for ambient water quality are prescribed by the Regulations on water categorization and classification.

The criteria for inter-republic and interstate watercourses are regulated by federal by-laws (Federal Government Gazette no. 8/78), whereas the criteria for the ambient waters within republics are regulated by republican by-lows.

All watercourses, i.e. its sections, in the FRY, are categorized depending on the planned purpose along each relevant river stretch. It is important to underline that the criteria for ambient water quality are regulated according to the average monthly low flow for the return period of 20 years ($Q_{95\%}$).

The table shows maximum permissible level (MPL) for the basic parameters of water quality for surface inland waters as proposed by the Federal Government (Gazette no. 8/78).

PARAMETAR	unit	Class I	Class II	Class III	Class IV
SSM* (dry whether)	g/m^3	10	30	80	100
TS** (dry whether)	g/m^3	350	1000	1500	1500
pH		6,8 - 8,5	6,8 - 8,5	6,0 - 9,0	6,0 - 9,0
Dissolved oxygen	g/m^3	8	6	4	3
Oxygen Saturation - under-saturation - super-saturation	%	90 -105 -	75 - 90 105 - 115	50 -75 115 - 125	30 - 50 125 - 130
BOD_5 (20°C)	gO_2/m^3	2	4	7	20
COD_{Mn}	gO_2/m^3	10	12	20	40
Saprobity index (Liebman)		oligo	β mezo	α-β mezo	α -mezo
MPN Colli	1/100 ml	2000	100000	200000	-
Visible Colour (VC)		none	none		-
Odour		none	none		-

* *SSM - Suspended solids,*

** *TS - Total Solids*

Class I - Water can be used for water supply in natural state or after disinfection, as well as for the supply of salmon fishponds

Class II - Water can be used for water supply after classical water treatment (e.g. coagulation, filtration, disinfection), as well as for supply of cyprinide fish ponds and recreational purposes

Class III - Water can be used for irrigation as well as for industrial water supply

Class IV - Water can not be used for any purpose except for the navigation

The criteria and standards for the surface water on the territory of the republics are defined by Republic regulations. In the Republic of Serbia, the ambient waters are categorized into four categories. In Republic of Crna Gora, in order to meet particular criteria of an declared Ecological State, the ambient waters are categorized into three categories.

The table shows MPL of basic parameters for surface inland waters as proscribed by the Government of the Republic of Serbia (Gazette No. 5/68).

PARAMETER	unit	Class I	Class IIa	Class IIb	Class III	Class IV
SSM (dry whether)	g/m^3	10	30	40	80	-
TS (dry whether) - surface water - groundwater	g/m^3	300 800	1000 1000	1000 1000	1500 1500	 - -
pH		6,8 - 8,5	6,8 - 8,5	6,5 - 8,5	6,0 - 9,0	-
Dissolved oxigen	g/m^3	8	6	5	4	0,5
BOD_5 (20°C)	gO_2/m^3	2	4	6	7	
Saprob. index (Liebman)		oligo	β -mezo	α-β mezo	α -mezo	-
MPN Colli	1/100 ml	200	6000	10000	-	-
Visible colour (VC)		none	none	none	-	-
Odour		none	none	none	-	-

Class I *Water can be used for water supply in natural state or after disinfection as well as to be used for supply of salmon fishponds*

Class II *Water can be used for water supply after classical water treatment (eg coagulation, filtration, desinfection) as well as to be used for supply of cyprinid fishponds and for recreation*

Class III *Water can be used for irrigation as well as for industrial water supply*

Class IV *Water can not be used for any purpose except for the navigation*

As mentioned above, in the Republic of Montenegro the standards are adjusted to the specific demands to meet particular criteria of an declared Ecological State. The following table shows MPL for the basic water quality parameters established for surface inland waters (Government Gazette No. 14/96).

PARAMETER	unit	Class A1	Class A2	Class A3
SSM (dry whether)	g/m^3	10	20	50
Water temp. (changes)	°C	1-3 °C	1-3 °C	1-3 °C
Conductivity (20°C)	µS/cm	400	600	1000
pH	-	6,8 - 8,5	6,5 - 9,0	5,5 - 9,0
Color (°Pt - Co)	g/m^3	5	10	20
Odor (dilut. factor at25°C)		0	3	10
Oxigen Saturation	%	> 80	> 70	> 50
BOD_5 (20°C)	gO_2/m^3	< 3	< 5	< 7
COD	gO_2/m^3	8	10	30
Amon. Nitroog. (as NH_4)	g/m^3	0,05	0,5	1
Nitrate Nitrog. (as NO_3)	g/m^3	20	25	50
Nitrite Nitrog. (as NO_2)	g/m^3	0,03	0,1	0,2
Phosphates (as P)	g/m^3	0,08	0,15	0,15
MPN Coli (37°C)	1/100 ml	50	5000	50000
Fecal Coliforms	1/100 ml	20	1000	10000
Tot. β radioactivity	Bq/L	0,1	0,1	0,1

Class A1 Water can be used for water supply in natural state or after desinfection

Class A2 Water can be used for water supply after classical water treatment (eg. coagulation, filtration, desinfection)

Class A3 Water can be used for water supply after advanced treatment (eg. coagulation, filtration, ozonation, GAC filtration, desinfection)

The standards for supply of salmon and cyrpinide fish ponds are regulated by separate by-laws.

The standards for the content of heavy metals in water used for irrigation are set only in the Republic of Serbia, because here lie the largest agricultural areas. The regulation on permissible concentrations of dangerous and harmful substances in land and irrigation water, as well as the methods of testing are published in Government Gazette No. 23/94. The following table shows regulated MPL value for given the elements.

Parameter	MPL in Soil (mg/kg)	MPL in Water for Irrigation (mg/L)
Cadmium	3	0.01
Lead	100	0.10
Mercury	2	0.001
Arsenic	25	0.05
Chromium	100	0.50
Nickel	50	0.10
Fluorine	300	1.50
Copper	100	0.10
Zinc	300	1.00
Boron	50	1.00

It is important to note that according to the FRY legislative there are no standards set for the effluents (except of the local municipal standards for discharge of waste water and effluents into municipal sewage systems). Its use to be indirectly determined for each particular case via recipient's standard for the given river section. These effluent standards proscribes responsible Water Authority on request of investors but its have to be certified by Ministry in the process of issuing of the so-called waterworks consent.

It has to be pointed out that there are not standards for river or lake sediments, nor do provisions of law regulate this issue.

As observed in the practice, there are certain weaknesses in the legislature related to monitoring of water quality and control. The regulations and standards have been imposed in various periods and in conditions of changes of state organization, so there are discrepancies, which should be eliminated and rectified. Nevertheless, the significant improvement might be done by the stricter implementation of existing regulations and standards.

Generally speaking, there is a need for the regulations related to the issue of water quality control to be renovated in accordance with new findings and experiences, as well as to be coordinated within the country and with related European regulations.

Relevant international agreements and International Co-operation

Following the disintegration of the Socialistic Federal Republic of Yugoslavia (SFRY), the FRY carried on, among other actions, the implementation of multilateral and bilateral agreements on waters with its neighbouring Danube Basin countries. These agreements were entered into because of mutual interests (flood and ice control, water resource management, protection of waters, etc.) and close hydrographical linkage.

Particularly striking is the hydrographical linkage with Romania, because many water courses from this country flow into the territory of the FRY, including: Zlatica (Aranka), Stari Begej (Bega Old), Tamis (Timis), Brzava, Moravica, Rojga, Karas and Nera, as well as the channels Plovni Begej (Bega Canal), Topolja Gaj, Stamora Gaj, etc. There is also quite a number of irrigation systems on both sides of the border making up entities (Galacka, Medja, Tamisac, Itebej, Keca-Zombolia, Dolina Birda, Dolina Lijaka, Konak, Banlok-Tolvadija, Partos, Miletic). An entity is also the underground water-bearing unit of Banat, which is used on the Yugoslav side for water supply purposes.

The joint sector of the Danube which makes a part of the border (about 213 km) between the two countries is another indicator of the close hydrographical linkage between the FRY and Romania. In order to corroborate the latter, let us also mention the fact that the quality of water in that sector of the Danube is substantially affected by the pollutants carried by the Romanian water courses within the Banat region.

The hydrographical linkage between the FRY and Hungary is also a close one, since the rivers Danube and Tisa, two streams (Plazovic, Keres) and Bajski channel flow into FRY from there. The two countries are also hydrographicaly linked by groundwater, since the deep water-bearing layer used for water supply purposes makes up an entity spreading in the southern part of Hungary and northern part of the FRY.

With reference to water quality control, particular importance is attached to the river Tisa, since it is the sole larger water resource for the Eastern Bačka region as well as for the Banat region, where around 500,000 people live.

The hydrographical linkage between the FRY and Bulgaria is not as big as the ones in case of Hungary and Romania. The following are the rivers whose watersheds are in the FRY and Bulgaria: Timok whose the lowest streach makes up the border between the two States, Visocica, Nisava, Jerma and the stream Gaberska, belonging to the Grand Morava, Danube and Black Sea watershed, as well as the steam Dragovistica which flows from FRY to Bulgaria but belongs to the Aegean watershed.

When consideration is given to international co-operation in the water sector, it should be borne in mind that with the disintegration of the former SFRY, several new states were established in its territory (Slovenia, Croatia and Bosnia and Herzegovina), which are hydrographically linked up by the river Sava. Full diplomatic relations have not been established between the FRY and all these states yet, so that despite a good knowledge of the mutual hydrological and hydraulic circumstances stemming from the earlier inter-republic co-operation within the former SFRY, direct co-operation relating to water utilisation and control has not been established yet.

Before 1991, the co-operation between the former SFRY and the Danube Basin countries in its neighbourhood concerning water management was an intensive one, but with its disintegration, this intensity decreased and with the introduction of the UN sanctions against the FRY in 1992, it was reduced to minimum not by volition of FRY.

With the alleviation of the UN sanctions from the FRY in 1996, the co-operation intensified (with Romania and Hungary) and showed a tendency to increase.

Hereinafter a summary of the international water management co-operation based on bilateral and multilateral agreements signed by, or succeeded to by the FRY, will be presented.

Bilateral Agreements with the Danube Countries

Romania:

Official co-operation between Yugoslavia and Romania in the field of water management has been going on for 67 years now (Convention on Navigation and Water Control Systems on Channels and River Plovni Begej, 1932). After the Second World War, co-operation was made official by the signature of the Agreement on River Engineering Matters Relating to Water Control Systems and Water Courses making up the State Border or cutting It, by the that time governments of the Federal People’s Republic of Yugoslavia (FPRY) and the People’s Republic of Romania, in 1955. That agreement covered all water sector matters relating to minor watercourses. However, it also applies to the river Danube concerning matters not regulated by the 1948 Convention on the Regime of Navigation on the Danube.

Several important documents defining this problem area in greater detail and allowing action were signed on the basis of that agreement. Among other things, the Mixed Yugoslav-Romanian Water Management Commission was established and it plays an important role in the implementation of co-operation.

The FRY and Romania co-operate the most in connection with the joint exploitation of hydroelectric plants (Iron Gate I and Iron Gate II) and the Danube as a waterway. Several important documents have been signed in that context, including:

- Agreement between the former SFRY and the PR of Rumania on the Construction and Exploitation of the Iron Gate Hydroelectric and Navigational System on the River Danube, 1963,
- Convention on the Exploitation of the Iron Gate Hydroelectric and Navigational System on the River Danube, 1963,

- Statute of the Mixed Yugoslav-Romanian Djerdap Commission, 1963, and
- Convention on the Exploitation and Maintenance of the Djerdap I and Djerdap II Hydroelectric and Navigational Systems (the Yugoslav-Rumanian Djerdap joint commission was formed on the basis of this convention and it works on matters of mutual concern).

Despite intensive and friendly co-operation, many tasks and duties stemming from the agreements made by the two countries have been performed to date, but not all. In that context, a special long-lived problem is posed by the heavily polluted rivers flowing from Romania, so that its water cannot be used even for irrigation purposes. It is obvious that water pollution control in Romanian part of Danube River Watershed is not on the needed level. It should be noted that a similar situation also exists in the FRY, so that a joint efforts to advance river water quality as well as the environment, particularly pursuant to the Danube Watershed Pollution Control Programme, would be of great benefit to the both countries.

Hungary:

The Agreement on Water Management Co-operation between FRY and Hungary was signed in 1955. This co-operation is conducted by the Yugoslav-Hungarian *Water Management Commission* dealing with matters of common concern, directs co-operation, reconciles the results of joint researches, etc.

Although many tasks and duties laid down in the agreements made by the two countries have been performed so far, quite a few of them are still outstanding (joint consideration and reconciliation of water control projects and construction of new facilities affecting the regime of waters, their quality and state of the ecosystems in the territory of the both countries, reconciliation of the operating rules for the Kiskere Dam and Becej Gate during medium and low flow conditions of Tisa River as well as the water regime and water quality control of the Plazovic stream and Keres stream (it empties into the Ludosko lake - the natural bird resort protected under the Ramsar Convention), both entering teritorry of FRY from the Hungary.

One of the most important tasks in the co-operation between the two countries is the start up and implementation of the Agreement on the Tisa Water Control, because the waters of this currently quite polluted river, are an important resource for the northern Banat region, as well as for the central and northern Backa region in the FRY, the population of which is about 600,000.

A matter of particular interest and concern in the FR of Yugoslavia is also the potential effect of the Paksz Nuclear Power Station off the Danube (about 100 km upstream from the state border).

Bulgaria:

The beginning of water management co-operation between Yugoslavia and Bulgaria is associated with the issue of training the river Timok. The water management co-operation between the two countries began with the signature of the Agreement on Water Management Matters between the Governments of the FPRY and the Peoples Republic of Bulgaria, 1958, but it was not an intensive one because of the small hydrographical linkage between the two countries. Anyway, there is the interest for improving cooperation in Water Resources Management.

Croatia and Bosna & Herzegovina

In hydrographical terms, the FRY is directly connected with Croatia and Bosnia and Herzegovina. A stretch of the Danube (about 138 km long) makes up the State border between the FRY and Croatia, and the rivers Bosut and Studva flow into Yugoslavia from Croatia. The Croatian rivers Drava and Vuka flow into the stretch of the Danube constituting the border between the two countries and indirectly affect the Danube water regime as well as its water quality in FRY.

Diplomatic relations have been established with Croatia, so that an inter-state legal frame exists for bilateral co-operation also in the field of water management and protection. The watershed of the river Drina (a major tributary of the river Sava) is in the territories of the FRY and Bosnia & Herzegovina (B & H), and the river itself makes up the border between the two states. Also, a stretch of Sava river makes up the border between the FRY and Bosnia & Herzegovina.

The diplomatic relations have not been established with B & H, so that there are no legal grounds for official co-operation. However, conditions exist for co-operation, particularly with the Srpska Republic, as the constitutive part of B & H, which has special relations with the FRY.

Multilateral Agreements

The FRY is the signatory of many multilateral agreements dealing with the protection of the Danube waters directly or indirectly, including:

1. *The Convention on the Regime of Navigation on the Danube*, signed in Belgrade in 1948 by: the USSR, People's Republic of Bulgaria, Republic of Hungary, People's Republic of Rumania, Republic of Ukraine, Czech Republic and Federal People`s Republic of Yugoslavia (as these countries were officialy called then). This Convention has been amended several times (latest amendments were made in 1998) and expanded to cover also other Danube Basin countries in the meanwhile.

   The mentioned Convention deals with matters relating to navigation and training and maintenance of the navigable stretch of the Danube, from Ulm in Germany to the Black Sea, and it produced a very favourable impact on the Danube training and organisation of co-operation between its signatories, the Danube Basin countries. The water pollution control was not covered by the original version of the Convention, but in 1986, the Danube Commission, the operating body of the Convention, determined measures for the prevention of pollution of the Danube by the vessels sailing on it. In that context, it was made necessary for all new vessels and the refitted or modernised ones to be provided with suitable devices for the collection and treatment of their own wastewater.
2. *The Agreement on the Protection of Waters within the Tisa River Watershed,* signed in 1988 under the auspices of COMECON by: SFRY, FR of Czechoslovakia, PR of Hungary, PR of Rumania and USSR, pursuant to the Final Act of the Conference on Security and Co-operation in Europe and UN Conference on Environmental Protection (Stockholm, 1971).

   The signatories of this Agreement assumed a number of commitments concerning the regulation of the river Tisa watershed, including the duty to apply measures towards preventing and reducing pollution, in accordance with their financial capacity and national laws and regulations. The SFRY ratified this Agreement, but it was never implemented because of the disintegration of the "Eastern Bloc" and the establishment of new states in the Tisa watershed.
3. Convention on Co-operation in the Protection and Sustainable use of the River Danube, signed in Sofia in 1994 by: Germany, Austria, Slovenia, Czech Republic, Slovakian Republic, Hungary, Romania, Bulgaria, Ukraine and Moldavia, and by Croatia and Bosnia and Herzegovina subsequently. The FRY actively participated in the drafting of this Convention (Sofia, 1991), but although it was very much open to and interested in co-operation, it was excluded from its further drafting and signature.
4. The FRY also signed *the Convention on the Cross-border Movement of Hazardous Material and its Storage* (Basle, 1989) and ratified *the Convention on the Protection of Wetlands and Wetland Ecosystems* (Ramsar, 1986). It also signed the Agenda 21 (Rio, 1991).

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Annexes

Tables

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Table 2.1-1: THE EMISSION OF WASTEWATER WITHIN DANUBE WATERSHED IN FR YUGOSLAVIA

Teritorry	Type of Wastewater	WW Dicharge (000 m3/g)	Susp. solids (t/g)	BOD5 (t/g)	PE	Tot. Nitrogen (tN/g)	Tot. Phosph. (tP/g)
REPUBLIC OF SERBIA (Danube Watershed)	Municipal	405187	107343	116592	5323858	19404	5830
	Industial (BOD dominated)	386916	300366	159077	7263792	6454	1972
	Industrial (Inorg. dominated)	436432	204253	13409	612285	16714	6130
	AMOUNT	**1228535**	**611962**	**289079**	**13199935**	**42572**	**13932**
REPUBLIC OF MONTENEGRO (Danube Watershed)	Municipal	13688	3016	3222	147133	602	163
	Industial (BOD dominated)	2628	475	410	18700	106	28
	Industrial (Inorg. dominated)	3869	1442	179	8183	23	5
	AMOUNT	**20185**	**4932**	**3811**	**174016**	**731**	**197**
FEDERAL REPUBLIC OF YUGOSLAVIJA (Danube Watershed)	Municipal	418874	110359	119815	5470991	20006	5993
	Industial (BOD dominated)	389544	300841	159487	7282492	6560	2000
	Industrial (Inorg. dominated)	440301	205695	13588	620468	16737	6135
	AMOUNT	**1248719**	**616895**	**292890**	**13373951**	**43303**	**14128**

Important note : Data are related to the pollution emission before 1991
The pollution emission in the period 1994-97 was 45-55% lower than presented

Sources : Water Master Plan of Repiblic of Serbia (final draft)
Water Master Plan of Repiblic of Montenegro (working draft)

Table 2.2.-1/1: High Priority Municipal Hot Spots (Costs and Effects)

No.	Hot Spot	WWTP Capacity	LOW LOAD BIOLOGICAL TREATMENT						HIGH LOAD BT WITH P PRECIPITATION						BT WITH NUTRIENTS REMOVAL					
			CO ST (000 USD)		Load removed (t/y)				CO ST (000 USD)		Load removed (t/y)				CO ST (000 USD)		Load removed (t/y)			
	City/Settlement	000 ES	INV	OMR/y	BOD_5	Tot. N	Tot. P	S. Sol.	INV	OMR/y	BOD_5	Tot. N	Tot. P	S. Sol.	INV	OMR/y	BOD_5	Tot. N	Tot. P	S. Sol.
	1	3	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1a	City of Belgrade (Central)	1600							#####	29500	####	876	1183	25965						
1b	City of Belgrade (Ostru`nic	60							12500	1400	1084	30	41	833						
2	Novi Sad (*Left Bank*)	350							52500	6800	5657	148	268	4685						
3	Ni{	300							45000	5913	5302	124	260	4463						
4	Pri{tina	250							39500	5854	3563	86	133	2886						
5	Zrenjanin	200	37500	4301	3932	160	214	3515												
6	Vrbas-Kula (REG)	180	34000	3900	3390	90	143	2720												
7	Leskovac	160							25200	3241	2874	44	119	2613						
8	Kru{evac	150							23625	3038	2779	50	71	2420						
9	^a~ak	150							23625	3038	2466	62	125	2115						
10	[abac	100							17500	2035	1912	43	102	1625						
11	Vranje	100							17500	2035	1853	43	83	1604						
12	Valjevo (CW)	100							9500	1300	1695	44	110	1348						
13	Subotica**	90													32750	3800	3600	550	165,0	4050
14	U`ice	75							13990	1642	1399	33	56	1048						
15	Zaje~ar	75							13990	1642	1315	31	50	1009						
16	Senta (CW)	75							7500	1150	1261	36	50	1024						
17	Bor	75							13990	1642	1258	22	39	986						
18	Pirot	75							13990	1642	1225	36	50	979						
19	Ro`aje	25							5688	615	355	6	11	272						
20	Blace	20													7508	850	310	38	13,0	200
21	Kola{in	10							2800	279	175	5	7	131						
22	Mojkovac	10							2800	279	118	3	5	106						
	AMOUNT	4230	71500	8201	7322	250	357	6234	#####	73044	####	1721	2761	56110	40258	4650	3910	588	178	4250

Notes : ** Enlarging and Upgrading of Existing WWTP

The investment cost for upgrading of sewerage systems and preatreatment of industrial wastewaters are not accounted

INV - Investment cost

OMR - Operation, Maintenance, Repear Cost

Lifetime of WWTP was assumed to be 25 years (Interest rate - 3 % per year)

CW - Civil Works are completed 80%

Table 2.2.-1: High Priority Municipal Hot Spots

No.	Hot Spot	First Recipient	$Q_{min.}$ 95%	Row W. Water Load	Current Treatm.			Current WWTP Capacity	Hydraulic Load	Pollution Load (t/y)				Needed WWTP Capacity	Shortage of Treatment Capacity	COMMENTS
	City/Settlement		m^3/s	000 p.e.	K	M	B	000 p.e.	000 m^3/y	BOD_5	Tot. N	Tot. P	S. Sol.	000 p.e.	000 p.e.	the reasons for WWTP comstruction
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	**City of Belgrade (high)**	Danube		1655	x			0	151000	36245	6041	1359	29775	1660	1660	
1a	*Central Sewage System*	Danube	1800	1600	x			0	146000	35040	5840	1314	28850	1600	1600	transboundary effect, influence on the aquatic ecosystem
1b	*Ostru`ni~ki Sew. Syst.*	Sava	285	55	x			0	5000	1205	201	45	925	60	60	protect. of drinking water resource, protect. of recreation area
2	Novi Sad (*Left Bank*)	Danube	1410	287	x			0	31142	6285	988	298	5205	350	350	protect. of drinking water resource, protect. of recreation area
3	Ni{	Ni{ava	4,58	269	x			0	28335	5891	826	289	4959	300	300	low dilution rate, influence on the aquatic ecosystem
4	Pri{tina	Sitnica	0,68	181	x			0	16500	3959	570	148	3207	250	250	low dilution rate, influence on the aquatic ecosystem
5	Zrenjanin	Begej	1,76	190	x			0	15750	4161	975	226	3905	200	200	low dilution rate, influence on the aquatic ecosystem
6	Vrbas-Kula (REG)	DTD Kanal	3,00	164	x			0	9450	3592	547	151	3022	180	180	protection of irrigation system & Tisa River
7	Leskovac	J. Morava	4,01	146	x			0	12600	3193	295	132	2903	160	160	low dilution rate, influence on the aquatic ecosystem
8	Kru{evac	Z. Morava	18,10	141	x			0	10100	3088	333	79	2689	150	150	low dilution rate, influence on the aquatic ecosystem
9	^a~ak	Z. Morava	4,35	125	x			0	10930	2740	410	139	2350	150	150	protection of drinking water resource, low dilution rate
10	[abac	Sava	285	97	x			0	8500	2124	287	113	1805	100	100	protection of drinking water resource
11	Vranje	J.Morava	0,57	94	x			0	9450	2059	286	92	1782	100	100	protection of drinking water resouce, low dilution rate
12	Valjevo (CW)	Kolubara	0,58	86	x			0	8750	1883	293	122	1498	100	100	protection of drinking water res., low dilution rate
13	Subotica**	Lakes; Pali} & Ludo{		190	x	x	x	110	17350	4161	696	187	4267	200	90	protect. of ecosystem & birds reserve, protect. of recreation area
14	U`ice	Djetinja	0,74	75	x			0	7300	1643	222	62	1164	75	75	protection of drinking water resouce, low dilution rate
15	Zaje~ar	V. Timok	1,30	67	x			0	5635	1461	205	55	1121	75	75	transboundary effect, protection of Timok River
16	Senta (CW)	Tisa	120	64	x			0	3690	1402	238	55	1138	75	75	protection of Tisa River
17	Bor	Borska r.	0,58	64	x			0	5494	1398	145	43	1095	75	75	transboundary effect, protection of Timok River
18	Pirot	Ni{ava	1,58	62	x			0	6106	1361	240	56	1088	75	75	protection of drinking water resource, low dilution rate
19	Ro`aje	Ibar	1,15	18	x			0	1575	394	38	12	302	25	25	protection of drinking water resource, low dilution rate
20	Blace** (REG)	Blata{nica	0,06	15	x	x	x	5	1250	329	48	15	211	20	15	protection of resetrvoir for water supply, low dilution rate
21	Kola{in	Tara	6,00	9	x			0	956	195	35	7	145	10	10	protect. of Tara River Canyon Reserve of Nature (UNESCO)
22	Mojkovac	Tara	6,82	6	x			0	630	131	19	5	118	10	10	protect. of Tara River Canyon Reserve of Nature (UNESCO)
	AMOUNT			**4004**				**115**	**362493**	**87694**	**13737**	**3648**	**73749**	**4340**	**4225**	

Remarks : * Four WWTP are planned (1 600 000 p.e + 2 x 200 000 p.e. + 1 x 55 000 p.e.)

** Upgrading and enlarging of existing WWTP is needed

CW - Civil Works completed 80% REG - Regional Sewage System

K - No Treatment M - Mechanical Treatment B - Biological Treatment

Table 2.2.-2 : Medium Priority Municipal Hot Spots

No.	Hot Spot	First Recipient	$Q_{min.}$ 95%	Row W. Water Load	Current Treat.			Current WWTP Capacity	Hydraulic Load	Pollution Load (t/y)				Needed WWTP Capacity	Shortage of Treatment Capacity	COMMENTS
	City/Settlement		m^3/s	000 p.e.	K	M	B	000 p.e.	000 m^3/y	BOD_5	Tot. N	Tot. P	S. Sol.	000 p.e.	000 p.e.	the reasons for WWTP comstruction
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	**City of Belgrade (med.)**		1800	400	x			0	36500	14848	2425	589	12432	710	710	
1a	*Batajni~ki Sewage Syst.*	Danube	1800	200	x			0	18250	4380	716	144	3715	200	200	transboundary effect, influence on the aquatic ecosystem
1b	*Banatski Sewage Syst.*	Danube	1800	200	x			0	18250	4380	776	194	3852	200	200	transboundary effect, influence on the aquatic ecosystem
2	Pan~evo	Danube	1800	168	x			0	12614	3679	571	190	3054	200	200	transboundary effect, influence on the aquatic ecosystem
3	Indjija-Pazova (REG)	Danube	1800	110	x			0	7620	2409	362	61	1811	110	110	protection of drinking groundwater resource
4	Kraljevo	Z. Morava	15,60	99	x			0	9800	2088	241	62	1373	100	100	low dilution rate, influence on ecosystem
5	Novi Pazar	Ra{ka	1,28	82	x			0	7600	1800	252	101	1605	100	100	protection of drinking water resource, low dilution rate
6	S. Mitrovica	Sava	285	81	x			0	6300	1776	292	75	1533	100	100	protection of drinking water resource
7	Smederevo	Dunav	1845	72	x	x		0	5169	1572	260	94	1229	100	100	transboundary effect, influence on the aquatic ecosystem
8	K.Mitrovica	Ibar	4,70	66	x			0	5040	1438	178	77	1318	75	75	protection of drinking water resource, low dilution rate
9	Po`arevac**	V. Morava	34,5	59	x	x	x	10	4433	1297	195	89	1116	75	65	low dilution rate, influence on ecosystem
10	Knja`evac	B.Timok	0,48	52	x			0	3150	1121	125	55	1008	60	60	low dilution rate, influence on ecosystem
11	Gnjilane	Bin. Morava	0,31	49	x			0	4090	1077	105	34	927	60	60	protection of drinking water resource, low dilution rate
12	Prokuplje	Toplica	0,77	41	x			0	3175	887	122	34	663	50	50	protection of drinking water resource, low dilution rate
13	Vladi~in Han	J. Morava	1,45	40	x			0	2520	884	88	38	684	50	50	protection of drinking water resource, low dilution rate
14	Bijelo Polje	Lim	10,25	39	x			0	4730	861	108	31	576	50	50	low dilution rate, influence on ecosystem
15	Po`ega	Skrapez	0,34	38	x			0	2520	836	86	31	702	45	45	low dilution rate, influence on ecosystem
16	]uprija	V. Morava	32,50	35	x			0	2849	761	102	29	468	40	40	protection of drinking water resource, low dilution rate
17	Pljevlja	]ehotina	2,08	32	x			0	4493	704	115	38	558	50	50	protection of drinking water resource, low dilution rate
18	Berane	Lim	9,38	31	x			0	4600	691	101	28	464	40	40	protection of drinking water resource, low dilution rate
19	Ruma	Sava	285	27	x	x	x	5	2500	591	93	22	385	35	30	protection of drinking water resource, low dilution rate
20	Lazarevac	Kolubara	1,24	25	x			0	2186	547	83	21	404	30	30	protection of drinking water resource, low dilution rate
21	Sjenica	Vapa	0,58	23	x			0	1969	505	65	15	375	25	25	low dilution rate, protect. of water supply reservoir
22	Lipljan	Sitnica	0,25	22	x			0	1929	490	72	21	327	25	25	protection of drinking water resource, low dilution rate
23	Gusinje	Lake Plavsko		4	x			0	721	88	20	5	127	5	5	protection of Lake Plavsko (reserve of Nature)
	AMOUNT			**1595**				**15**	**136508**	**34862**	**5129**	**1488**	**28274**	**1825**	**1810**	

Remarks : * Four WWTP are planned (1 600 000 p.e + 2 x 200 000 p.e. + 1 x 55 000 p.e.)

** Upgrading and enlarging of existing WWTP is needed

CW - Civil Works completed 80% REG - Regional Sewage System

K - No Treatment M - Mechanical Treatment B - Biological Treatment

Table 2.2.-3 : Low Priority Municipal Hot Spots

No.	Hot Spot	First Recipient	$Q_{min.}$ 95%	Row W.Water Load	Current Treat.			Current WWTP Capacity	Hydraulic Load	Pollution Load (t/y)				Needed WWTP Capacity	Shortage of Treatment Capacity	COMMENTS
	City/Settlement		m^3/s	000 p.e.	K	M	B	000 p.e.	000 m^3/y	BOD_5	Tot. N	Tot. P	S. Sol.	000 p.e.	000 p.e.	the reasons for WWTP comstruction
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Loznica	Drina	51,00	38	x			0	1973	819	70	29	590	50	50	protection of potential water supply resource
2	Novi Sad (right bank)	Danube	1410	31	x			0	2100	669	79	16	465	40	40	protection of ecosystem, protection of recreational area
3	Prijepolje	Lim	11,33	30	x			0	2177	659	73	26	485	40	40	protection of ecosystem, protection of recreational area
4	Priboj	Lim	19,40	28	x			0	2520	603	59	31	460	40	40	protection of ecosystem, protection of recreational area
5	Kovin	Danube	1800	22	x			0	1580	480	54	15	325	25	25	protection of nature & the recreation area
6	Ivanjica	Moravica	0,74	18	x			0	1775	388	45	17	259	25	25	low dilution rate, influence on ecosystem
	AMOUNT			**167**				**0**	**12125**	**3618**	**380**	**134**	**2584**	**220**	**220**	

Remarks : K - No Treatment M - Mechanical Treatment B - Biological Treatment

Hot SpppSpp o pp p pS

No.	Pollution Source	Location	Priority	Number of Fatlings		Hydraulic Load	Pollution Load				
	Pig Farm	the nearest Settlement		per Year *	per Cycle	(m^3/y)	p.e.	BOD_5 (t/y)	Tot.N (t/y)	Tot. P (t/y)	Susp. Sol. (t/y)
	1	2	3	6		8	9	13	14	15	16
1	DD IM "Neoplanta" (DP "^enej")	Sirig	High	50000	25000	96725	67000	1460,0	182,5	68,4	3193,8
2	FS "Sur~in"	Sur~in	High	35000	17500	67708	47000	1022,0	127,8	47,9	2235,6
3	DD "Carnex-Farmakop"	Vrbas	High	35000	17500	67708	47000	1022,0	127,8	47,9	2235,6
4	DP PIK "Varvarinsko Polje"	Varvarin	High	25000	12500	48363	34000	730,0	91,3	34,2	1596,9
5	DP "1. Decembar"-FS "Nimes"	@itoradja	High	20000	10000	38690	27000	584,0	73,0	27,4	1277,5
6	FS "D. Markovi}"	Obrenovac	High	20000	10000	38690	27000	584,0	73,0	27,4	1277,5
	AMOUNT		HIGH	185000	92500	357883	249000	5402,0	675,3	253,2	11816,9
1	PP "Panonija"	Se~anj	Medium	30000	15000	58035	40000	876,0	109,5	41,1	1916,3
2	DP "Petrovac"	Petrovac na Mlavi	Medium	22000	11000	42559	30000	642,4	80,3	30,1	1405,3
3	PKB "Vizelj"	Padinska Skela	Medium	25000	12500	48363	34000	730,0	91,3	34,2	1596,9
4	DP-IM Farma Svinja	Velika Plana	Medium	20000	10000	38690	27000	584,0	73,0	27,4	1277,5
5	PD "Zvezdan"	Zaje~ar	Medium	20000	10000	38690	27000	584,0	73,0	27,4	1277,5
6	DP "Elan"	Srbobran	Medium	17000	8500	32887	23000	496,4	62,1	23,3	1085,9
7	FS "Turekovac"	Leskovac	Medium	15000	7500	29018	20000	438,0	54,8	20,5	958,1
	AMOUNT		MEDIUM	149000	74500	288241	201000	4350,8	543,9	203,9	9517,4

Note : 1) Two equal cycles per year

2) No any farm discharges wastewater directly into recipients but into lagoon. The wastes use to be disposed on to land after maturation. There is a danger of accidental pollution when lagoons are overloaded

Table 2.4.-1 : Industrial Hot Spots (All Priorities)

No.	Pollution Source	Type of Industry	Nearest Settlement	Recipient	Priority	Hydraulic Load	Pollution Load (Row wastewater)										
	Industry						BOD_5	COD	SS	N	P	Fe	Zn	Pb	Cr	Cu	Cd
						000 m^3/y	t/y	t/y	t/y	t/y	t/y	t/y	t/y	t/y	t/y	t/y	t/y
1	IHP 'Prahovo'	P - Fertilisers Production	Prahovo	Danube	High	26200	555	2530	27990	570	4760	-	146	80,9	10,20		-
2	TE 'Obilić'	Thermopower Plant, Coal Mining & Processing	Obilić	Sitnica	High	20700	4317	12100	26872	-		15,2	-	-	0,00		-
3	HI "Zorka"	Chemical Industry	Šabac	Sava r.	High	8000	285	725	3084	1465	-	606	1,29	1,66	0,00	1,28	0,28
4	RTB 'Bor'	Cu Mining & Flotation	Bor	Borska r.	High	6890	723	2710	810	38	-	19,3	9,64	1,17	2,07	17,9	-
5	FAK "Lepenka"	Wood & Paper Industry	N. Kneževac	Tisa	High	2205	1380	3980	4500	27	10	-	-	-	-	-	-
6	FOPA	Wood & Paper Industry	Vladičin Han	J. Morava	High	2050	15947	52500	4148	-	-	-	-	-	0,00		-
7	F-ka Šećera "Kristal"	Sugar Mill	Senta	Tisa r.	High	2240	3750	6950	4017	22	3	-	-	-	-	-	-
8	REIK " Kolubara"	Thermopower Plant, Coal Mining & Processing	Lazarevac	Kolubara	Medium	19900	3790	11250	4099	0,11	-	36,7	0,54	1,52	0,11	0,11	0,1
9	TENT-A	Thermopower Plant	Obrenovac	Sava r.	Medium	10300	225	700	1184	30,9	-	27,2	0,74	0,22	30,90	0,3	-
10	PK "Beograd"	Food Processing Ind.	Beograd	Danube	Medium	8350	13550	28700	3360	355	47	-	-	-	-	-	-
11	TE "Pljevlja"	Thermopower Plant, Coal Mining & Processing	Pljevlja	Ćehotina	Medium	6000	90	290	300								
12	F-ka šećera "Crvenka"	Sugar Mill & Destillery	Crvenka	DTD Canal	Medium	1750	2980	6150	3270	-	-	-	-	-	-	-	-
13	RTB "Bor"	Cu Mining & Flotation	Majdanpek	Pek r.	Medium	1280	-	-	565	0,37	-	4,7	-	0,07	0,00	0,15	-
14	RTK "Trepča"- Flotacija	Pb & Zn Mining, Flotation	Zvečan	Ibar r.	Medium	1040	-	-	10406	-	-	7,88	0,02	0,05	0,04	-	-
15	RTK "Trepča"- Flotacija "Kišnica"	Pb & Zn Mining, Flotation	Kišnica	Gračanka	Medium	500	-	-	490	-	-	-	-	-	-	-	
	AMOUNT					117405	####	1E+05	95095	2508	4820	717	158	85,6	43,3	19,7	0,38

Notes : 1) The data concerns on the period before 1992 when Industriy was opperated by 90% of full capacity

2) As the industrial production was severely decreased after the year 1992, the pollution emission in the period 1994-97 was 55-65% lower than presented in the table

3) Not all industries discharge wastewater directly into recipients. A part of it is retained in storages, retention basins or lagoons

Tab. 4.1-1 : The Coordinates of Gauging Stations within the Danube River Watershed in FRY

N°	ID N°	Station	River	Latitude & Longitude		Start of Record	Dist. from the mouth (km)	Catchm. area (km^2)	Zero point of gauge (a.A.s.l)*
				l	j				
1	42010	Bezdan	Danube	45°51,3'	18°51,9'	1856	1425,5	210250	80,64
2	42015	Apatin	Danube	45°40,2'	18°58,2'	1875	1401,4	211139	78,84
3	42020	Bogojevo	Danube	45°31,8'	19°04,9'	1871	1367,4	251593	77,46
4	42035	Novi Sad	Danube	40°15,3'	19°51,4'	1819	1255,5	254085	71,73
5	42040	Slankamen	Danube	45°08,3'	20°16,0'	1888	1215,5	254961	69,68
6	42045	Zemun	Danube	44°50,7'	20°25,2'	1859	1174	412762	67,87
7	42050	Pan~evo	Danube	44°52,0'	20°38,4'	1870	1153,3	525009	67,33
8	42056	Kovin	Danube	44°43,7'	20°58,9'	1884	1108,4	526952	65,66
9	42055	Smederevo	Danube	44°40,0'	20°55,4'	1920	1116	525820	65,36
10	42060	Banatska Palanka	Danube	44°49,6'	21°20,4'	1957	1076,6	568648	62,85
11	42065	Veliko Gradi{te	Danube	44°46,2'	21°31,6'	1925	1059,2	570375	62,17
12	42070	Golubac	Danube	44°39,0'	21°38,2'	1925	1042		62,87
13	42075	Donji Milanovac	Danube	44°28,1'	22°09,7'	1946	995		62,24
14	42090	Brza Palanka	Danube	44°25,0'	22°30,2'	1933	883,8		37,01
15	42095	Prahovo	Danube	44°17,0'	22°35,2'	1925	861		29,02
16	44010	Novi Kne`evac	Tisa	46°03,0'	20°05,2'	1883	144,5	140,1	73,57
17	44020	Senta	Tisa	45°56,2'	20°05,7'	1855	123,4	141715	72,80
18	44030	Novi Be~ej	Tisa	45°35,7'	20°08,2'	1865	65	145415	71,87
19	44040	Titel	Tisa	45°12,2'	20°19,1'	1965	9,8	157174	69,70
20	44220	Zrenjanin	Begej	45°22,8'	20°23,9'	1896	31,2	5566	73,90
21	45085	Sremska Ra~a	Sava	44°53,5'	19°20,8'	1890	175,2	64488	74,66
22	45090	Srem. Mitrovica	Sava	44°57,6'	19°36,7'	1921	136	87996	72,22
23	45094	[abac	Sava	44°46,0'	19°42,1'	1948	102,6	89490	72,61
24	45096	Beljin	Sava	44°37,7'	19°57,3'	1920	64	90623	69,99
25	45099	Beograd	Sava	44°49,2'	20°27,3'	1912	2	95719	68,28
26	45865	Bajina Ba{ta	Drina	43°58,0'	19°32,9'	1905	160	14797	211,47
27	45882	Radalj	Drina	44°25,2'	19°09,2'	1956	85,5	17493	129,42
28	45960	Trebaljevo	Tara	42°51,5'	19°31,9'	1959	109	506	894,08
29	45975	\ur|evi}a Tara	Tara	43°08,8'	19°17,9'	1953	56	1381	618,24
30	45807	Gradac	]ehotina	43°23,8'	19°09,2'	1898	55,5	809,8	665,00
31	45823	Plav	Lim	42°36,0'	19°56,3'	1970	196,8	364	906,58
32	45827	Berane	Lim	42°52,0'	19°52,8'	1957	155	1283	658,05
33	45832	Bijelo Polje	Lim	43°01,9'	19°45,0'	1960	124,9	2183	559,67
34	45834	Dobrakovo	Lim	43°08,2'	19°46,9'	1958	111,2	2875	531,61
35	45837	Prijepolje	Lim	43°23,0'	19°38,1'	1959	74,5	3160	443,37
36	45842	Priboj	Lim	43°34,8'	19°31,9'	1892	47,2	3684	380,79
37	45828	Bio~a	Lje{nica	42°55,9'	19°51,6'	1967	0,4	207	627,99
38	45890	Zavlaka	Jadar	44°26,8'	19°30,4'	1926	39,2	313	153,65
39	45905	Valjevo	Kolubara	44°16,1'	19°53,6'	1953	80,3	340	179,65
40	45908	Slovac	Kolubara	44°20,3'	20°05,1'	1950	54,7	995	121,59
41	45920	Dra`evac	Kolubara	44°35,6'	20°13,5'	1923	12	3588	72,38
42	45922	Obrenovac	Kolubara	44°39,0'	20°13,2'	1953	2,8	3636	69,83
43	45903	Sedlare	Jablanica	44°15,3'	19°50,6'	1953	3,1	140	217,74
44	45909	Bogova|a	Ljig	44°19,7'	20°12,5'	1954	6,35	679	109,26

N°	ID N°	Station	River	Latitude & Longitude		Start of Record	Dist. from the mouth (km)	Catchm. area (km^2)	Zero point of gauge (a.A.s.l)*
				l	j				
45	45912	Zeoke	Pe{tan	44°24,2'	20°20,1'	1954	9	125,4	108,02
46	45914	Koceljevo	Tamnava	44°28,2'	19°49,2'	1970	43,2	208	120,31
47	45916	Ub	Ub	44°27,5'	20°04,5'	1969	8,9	214	90,01
48	42401	Ja{a Tomi}	Tami{	45°25,9'	20°51,6'	1925	122,7	5790	73,46
49	42420	Toma{evac	Tami{	45°16,5'	20°36,9'	1924	92,2	9717	70,98
50	42435	Glogonj	Tami{	44°59,0'	20°31,2'	1873	31,2	10233	69,52
51	47010	Varvarin	Grand Morava	43°43,0'	21°22,2'	1923	237,2	31548	126,12
52	47030	]uprija	Grand Morava	43°56,2'	21°22,5'	1952	191	32561	112,49
53	47040	Bagrdan	Grand Morava	44°04,3'	21°12,1'	1924	154,2	33446	100,94
54	47090	Ljubi~evski Most	Grand Morava	44°35,0'	21°07,0'	1922	34,8	37320	73,42
55	47520	Ristovac	South Morava	42°28,4'	21°50,5'	1945	238	2132	383,29
56	47528	Vranjski Priboj	South Morava	42°36,2'	22°01,0'	1937	211,6	2775	349,98
57	47530	Vladi~in Han	South Morava	42°42,4'	22°04,1'	1922	195	3052	321,71
58	47540	Grdelica	South Morava	42°54,0'	22°04,2'	1922	163	3689	251,78
59	47550	Korvingrad	South Morava	43°12,6'	21°50,2'	1926	100,7	9396	188,09
60	47570	Aleksinac	South Morava	43°35,2'	21°42,9'	1950	61,8	14284	157,61
61	47590	Mojsinje	South Morava	43°37,9'	21°29,4'	1966	18,1	15390	136,28
62	47510	Donje Kormijane	Bina~ka Morava	42°31,0'	21°36,1'	1986	269	1017	423,42
63	47503	Kosovska Vitina	Bina~ka Morava	42°19,0'	21°21,8'	1961	313	111,2	495,37
64	47640	Vlasotince	Vlasina	42°58,0'	22°08,2'	1956	10,4	879	254,39
65	47665	Leskovac	Veternica	43°00,0'	21°57,2'	1963	11,7	500	223,65
66	47740	Pe~enjevce	Jablanica	43°06,0'	21°56,2'	1922	2,7	891	207,18
67	47548	Pukovac	Pusta	43°10,0'	21°51,2'	1957	4,5	561	194,38
68	47820	Magovo	Toplica	43°15,1'	21°03,4'	1957	106,8	180,5	523,15
69	47860	Pepeljevac	Toplica	43°08,5'	21°18,4'	1928	72,2	986	329,90
70	47880	Prokuplje	Toplica	43°14,0'	21°34,2'	1922	33,5	1805	234,95
71	47890	Doljevac	Toplica	43°12,0'	21°50,2'	1957	1,8	2083	190,41
72	47910	Dimitrovgrad	Ni{ava	43°00,7'	22°46,1'	1922	142	344	440,40
73	47920	Pirot	Ni{ava	43°09,6'	22°35,6'	1924	111,2	1745	364,27
74	47950	Bela Palanka	Ni{ava	43°13,9'	22°19,5'	1922	70,7	3087	283,15
75	47990	Ni{	Ni{ava	43°19,6'	21°54,1'	1963	21,4	3974	188,45
76	47911	Mrtvine	Gaberska	42°59,8'	22°46,7'	1963	3	232	452,86
77	47905	Strazimirovci	Jerma	42°47,6'	22°21,0'	1963	58,4	95,5	802,23
78	47914	Trnski Odorovci	Jerma	42°55,8'	22°38,2'	1958	21,5	557	552,58
79	47945	Stani~enje	Tem{tica	43°12,7'	22°31,2'	1957	0,5	818	335,44
80	47975	Radikine bare	Kutinska	43°15,2'	22°00,8'	1963	8,7	205,5	232,12
81	47934	Izatovac	Viso~ica	43°07,2'	22°53,1'	1958	38,6	156	753,11
82	47102	Kratovska stena	West Morava	43°52,2'	20°07,4'	1938	206	3077	290,44
83	47115	^a~ak	West Morava	43°53,8'	20°21,5'	1923	170,7	3450	234,04
84	47125	Milo~ajski most	West Morava	43°47,0'	20°38,2'	1955	119	4658	194,27
85	47130	Kraljevo	West Morava	43°44,0'	20°44,4'	1940	104,5	4721	184,54
86	47150	Trstenik	West Morava	43°37,6'	21°00,3'	1940	63,5	13902	160,60
87	47195	Jasika	West Morava	43°36,4'	21°18,0'	1922	20,5	14721	139,11
88	47350	Arilje	Moravica	43°45,7'	20°06,6'	1958	13,7	830,5	326,69
89	47380	Arilje	Veliki Rzav	43°45,3'	20°05,3'	1958	2,2	585	327,39
90	47420	Stapari	\etinja	43°50,5'	19°45,0'	1976	38,5	332	514,05

N°	ID N°	Station	River	Latitude & Longitude		Start of Record	Dist. from the mouth (km)	Catchm. area (km²)	Zero point of gauge (a.A.s.l)*
				l	j				
91	47430	[engolj	\etinja	43°48,5'	20°01,4'	1980	10	511	310,00
92	47495	Po`ega	Skrape`	43°50,2'	20°02,8'	1977	4,6	616	303,39
93	47105	Gu~a	Bjelica	43°46,9'	20°14,1'	1960	19	239	329,19
94	47121	Br|ani	Di~ina	43°58,3'	20°24,1'	1949	7,3	208	259,34
95	47207	Ba~	Ibar	42°54,0'	20°19,0'	1978	239,6	411	
96	47220	Prelez	Ibar	42°54,2'	20°45,1'	1934	182	1109	542,61
97	47255	Leposavi}	Ibar	43°06,1'	20°48,0'	1923	131	4701	445,32
98	47260	Ra{ka	Ibar	43°17,3'	20°37,2'	1925	94,3	6268	394,10
99	47290	U{}e	Ibar	43°28,0'	20°37,5'	1935	58	6883	329,89
100	47295	Lopatnica Lakat	Ibar	43°39,5'	20°34,2'	1922	26,5	7818	224,68
101	47299	Kraljevo	Ibar	43°43,3'	20°41,1'	1953	7	7925	192,76
102	47230	Dobri Dub	Sitnica	42°38,6'	21°04,1'	1963	51,5	1314	527,80
103	47248	Nedakovac	Sitnica	42°48,1'	20°59,7'	1957	26	2590	511,48
104	47232	Pri{tina	Pri{tevka	42°40,2'	21°10,4'	1957	10,4	53	588,00
105	47245	Milo{evo	Lab	42°43,8'	21°05,2'	1959	11,4	923	530,16
106	47265	Novi Pazar	Ra{ka	43°08,1'	20°31,5'	1923	24,5	472	488,29
107	47269	Ra{ka	Ra{ka	43°17,0'	20°37,4'	1956	0,3	1036	396,44
108	47288	U{}e	Studenica	43°28,1'	20°36,2'	1953	3,5	540	352,32
109	47167	Razbojna	Rasina	43°21,2'	21°10,2'	1922	46	438	290,17
110	47175	Bivolje	Rasina	43°35,4'	21°21,0'	1983	5,5	958	141,96
111	47025	Para}in	Crnica	43°51,4'	21°24,4'	1957	5,05	338	125,16
112	47029	]uprija	Ravanica	43°55,6'	21°24,2'	1973	1,2	161,2	117,88
113	47034	Majur	Lugomir	43°56,6'	21°17,1'	1957	12,7	427	123,29
114	47038	Jagodina	Belica	43°58,6'	21°15,6'	1973	10,6	193	114,09
115	47058	Bato~ina	Lepenica			1956	7	518	104,51
116	47067	Svilajnac	Resava	44°14,0'	21°11,2'	1958	3,75	681	97,20
117	47075	Smed. Palanka	Jasenica	44°20,8'	20°57,1'	1956	13,7	496	101,82
118	47076	Smed. Palanka	Kubr{nica	44°21,8'	20°57,7'	1957	2,3	743,2	102,80
119	47083	Mladenovac	Veliki Lug	44°25,9'	20°41,9'	1949	13	122	129,01
120	42530	Ra{anac	Mlava	44°27,0'	21°20,2'	1965	46,3	1063	101,88
121	42540	Kula	Vitovnica	42°58,9'	22°16,3'	1982	10,2	243	106,28
122	42720	Ku~evo	Pek	44°28,8'	21°39,2'	1984	44,5	849,5	147,16
123	42730	Kusi}i	Pek	44°43,0'	21°32,5'	1966	6,6	1220	76,31
124	42810	Topolnica	Pore~ka	44°23,0'	22°10,7'	1951	8,6	455	77,41
125	42770	Crnajka	[a{ka	44°18,4'	22°08,3'	1951	0,3	235,8	137,97
126	42760	Crnajka	Crnajka	44°18,2'	22°08,6'	1979	0,4	96	175,79
127	42902	Brusnik	Timok	44°02,1'	22°22,7'	1925	21,5		61,68
128	42925	Vratarnica	Beli Timok	43°47,1'	22°18,7'	1923	20	1771	149,76
129	42929	Zaje~ar	Beli Timok	43°53,5'	22°18,0'	1980	4	2150	124,41
130	42914	Gamzigrad	Crni Timok	43°55,5'	22°10,9'	1973	19,2	1199	152,20
131	42906	Rgotina	Borska	44°00,4'	22°16,6'	1964	10	340	150,31
132	47263	Pazari{te	Ra{ka	43°07,8'	20°25,7'	1953	28,6	255,5	543,62

* a.A.s.l. - above **Adriatic** sea level

Source : Federal Hydrometheorological Institute

TABLE 4.1-2 : Index of Water Quality and Discherges Records

Name of Station Station ID No.	River	River Bank	Distance from the Mouth (km)	Number of Years of Records and the Latest Year of Record or Each of the Following Categories of Parameters						
				Water Discharge	Susp. Sed. Discharge	N	P	BOD_5 or COD	Heavy Metals	Other Toxics
Bezdan [TBS] 42010	Danube	left	1425.5			34/98	19/98	34/98	25/98	25/98
Apatin [BS] 42015	Danube	left	1401.4			19/98	19/98	19/98	17/98	17/98
Bogojevo [BS] 42020	Danube	left	1367.4			34/98	19/98	34/98	24/98	24/98
Novi Sad 42035	Danube	left	1258.0			34/98	19/98	34/98	25/98	25/98
Novi Banovci 42040	Danube	right	1189.0			17/98	15/98	17/98	17/98	17/98
Zemun 42045	Danube	right	1174.0			34/98	15/98	34/98	25/98	25/98
Smederevo 42055	Danube	right	1116.2			34/98	15/98	34/98	25/98	25/98
Banatska [TBS] Palanka 42060	Danube	left	1076.6			19/98	19/98	19/98	19/98	17/98

Table 4.1-2 (continue)

Name of Station Station ID No.	River	River Bank	Distance from the Mouth (km)	Number of Years of Records and the Latest Year of Record or Each of the Following Categories of Parameters						
				Water Discharge	Susp. Sed. Discharge	N	P	BOD_5 or COD	Heavy Metals	Other Toxics
Vel. Gradište [BS] 42065	Danube	right	1059.2			31/98	15/98	31/98	25/98	25/98
Tekija [BS] 42085	Danube	right	956.6			7/98	7/98	7/98	7/98	7/98
Brza Palanka [BS] 42090	Danube	right	883.3			7/98	7/98	7/98	7/98	7/98
Radujevac [TBS] 42095	Danube	right	851.0			34/98	15/98	34/98	25/98	25/98
Martonoš [TBS] 44010	Tisa	right	152.0			34/98	19/98	34/98	25/98	25/98
Novi Bečej 44030	Tisa	left	66.0			34/98	19/98	34/98	25/98	25/98
Titel 44040	Tisa	right	5.0			34/98	19/98	34/98	25/98	25/98
Bački Breg [TBS] 42110	Bajski Canal	left	2.0			19/98	19/98	19/98	19/98	19/98

Table 4.1-2 (continue)

Name of Station Station ID No.	River	River Bank	Distance from the Mouth (km)	Number of Years of Records and the Latest Year of Record or Each of the Following Categories of Parameters						
				Water Discharge	Susp. Sed. Discharge	N	P	BOD_5 or COD	Heavy Metals	Other Toxics
Jamena [TBS] 45084	Sava	left	201.0			19/98	19/98	19/98	18/98	18/98
Sremska Mitrovica 45090	Sava	left	138.0			34/98	19/98	34/98	25/98	25/98
Šabac 45094	Sava	right	102.6			34/98	15/98	34/98	25/98	25/98
Ostružnica 45098	Sava	right	41.0			34/98	15/98	34/98	25/98	25/98
Batrovci [TBS] 45088	Bosut	right	33.0			19/98	19/98	19/98	19/98	19/98
Morović [TBS] 45089	Studva	right	3.0			19/98	19/98	19/98	17/98	17/98
Crna Bara [TBS] 44028	Zlatica	right	33.0			19/98	19/98	19/98	18/98	18/98
Hetin [TBS] 44201	Bega Old	right	36.0			19/98	19/98	19/98	19/98	19/98

Table 4.1-2 (continue)

Name of Station Station ID No.	River	River Bank	Distance from the Mouth (km)	Number of Years of Records and the Latest Year of Record or Each of the Following Categories of Parameters						
				Water Discharge	Susp. Sed. Discharge	N	P	BOD_5 or COD	Heavy Metals	Other Toxics
Srpski Itebej [TBS] 44211	Bega Canal	left	29.0			34/98	19/98	34/98	25/98	25/98
Stajićevo 44214	Bega Canal	left	19.0			34/98	19/98	34/98	25/98	25/98
Jaša Tomić [TBS] 42401	Timis	right	116.0			34/98	19/98	34/98	25/98	25/98
Pančevo 42450	Timis	left	1.0			32/98	19/98	32/98	25/98	25/98
Markovićevo [TBS] 42480	Brzava	left	18.0			19/98	19/98	19/98	19/98	19/98
Vatin [TBS] 42485	Moravica	right	15.0			19/98	19/98	19/98	18/98	18/98
Dobričevo [TBS] 42615	Karaš	left	14.0			19/98	19/98	19/98	18/98	18/98
Kusić [TBS] 42660	Nera	right	21.0			19/98	19/98	19/98	18/98	18/98

Table 4.1-2 (continue)

Name of Station Station ID No.	River	River Bank	Distance from the Mouth (km)	Number of Years of Records and the Latest Year of Record or Each of the Following Categories of Parameters						
				Water Discharge	Susp. Sed. Discharge	N	P	BOD_5 or COD	Heavy Metals	Other Toxics
Srbobran 44105	Krivaja	right	1.0			18/98	18/98	18/98	6/98	5/98
Sombor 42100	DTD Canal	left	61.0			18/98	17/98	18/98	7/98	7/98
Vrbas II 42105	DTD Canal	right	2.0			18/98	17/98	18/98	10/98	10/98
Srpski Miletić 42150	DTD Canal	left	77.0			18/98	18/98	18/98	8/98	8/98
Bačko Gradište 42110	DTD Canal	right	4.2			34/98	17/98	34/98	25/98	25/98
Novi Sad - 1 42120	DTD Canal	right	5.0			18/98	17/98	18/98	6/98	6/98
Bač 42160	DTD Canal	left	34.0			18/98	17/98	18/98	6/98	3/98
Bački Petrovac 42170	DTD Canal	left	5.0			18/98	17/98	18/98	7/98	3/98

Table 4.1-2 (continue)

Name of Station Station ID No.	River	River Bank	Distance from the Mouth (km)	Number of Years of Records and the Latest Year of Record or Each of the Following Categories of Parameters						
				Water Discharge	Susp. Sed. Discharge	N	P	BOD_5 or COD	Heavy Metals	Other Toxics
Melenci 44150	DTD Canal	right	127.0			20/98	17/98	20/98	19/98	19/98
Kajtasovo 42640	DTD Canal	right	8.7			17/98	17/98	17/98	9/98	7/98
Bastasi * 45801	Drina	right	317.0			/	20/98	34/98	/	34/98
Bajina Bašta [TBS] 45865	Drina	right	160.0			32/98	15/98	32/98	25/98	25/98
Crna Bara [TBS] 45897	Drina	right	6.0			18/98	15/98	18/98	14/98	14/98
Đurđevića Tara [TBS] 45975	Tara	right	56.0			33/98	/	33/98	/	/
Gradac [TBS] 45807	Ćehotina	right	55.5			31/98	/	31/98	/	/
Dobrakovo 45834	Lim	right	109.8			25/98	/	25/98	/	/

* Nowdays the Station "Bastasi" is seated at territory of Bosna &Hercegovina – Srpska Republic. It is located close to the confluence of Tara and Piva, rivers forming Drina River.

Table 4.1-2 (continue)

Name of Station Station ID No.	River	River Bank	Distance from the Mouth (km)	Number of Years of Records and the Latest Year of Record or Each of the Following Categories of Parameters						
				Water Discharge	Susp. Sed. Discharge	N	P	BOD_5 or COD	Heavy Metals	Other Toxics
Prijepolje 45837	Lim	right	74.5			32/98	15/98	32/98	25/98	25/98
Priboj TBS 45842	Lim	right	47.2			19/98	15/98	19/98	6/98	5/98
Slovac 45908	Kolubara	left	54.7			34/98	15/98	34/98	25/98	25/98
Draževac 45920	Kolubara	right	12.0			34/98	15/98	34/98	25/98	25/98
Varvarin 47010	Grand Morava	right	327.2			18/98	15/98	18/98	14/98	14/98
Bagrdan 47040	Grand Morava	left	154.2			34/98	15/98	34/98	25/98	25/98
Ljubičevski most 47090	Grand Morava	right	34.8			34/98	15/98	34/98	25/98	25/98

Table 4.1-2 (continue)

Name of Station Station ID No.	River	River Bank	Distance from the Mouth (km)	Number of Years of Records and the Latest Year of Record or Each of the Following Categories of Parameters						
				Water Discharge	Susp. Sed. Discharge	N	P	BOD_5 or COD	Heavy Metals	Other Toxics
Gugaljski Most 47101	West Morava	right	208.0			34/98	15/98	34/98	25/98	25/98
Kraljevo 47130	West Morava	right	104.5			34/98	15/98	34/98	25/98	25/98
Maskare 47198	West Morava	right	2.0			13/98	13/98	13/98	13/98	12/98
Prelez 47220	Ibar	right	182.0			33/98	15/98	33/98	24/98	24/98
Raška 47260	Ibar	left	57.7			32/98	15/98	32/98	14/98	14/98
Kraljevo 47299	Ibar	left	7.0			34/98	15/98	34/98	25/98	25/98
Nedakovac 47248	Sitnica	right	26.0			34/98	15/98	34/98	25/98	25/98
Ristovac 47520	South Morava	right	238.0			34/98	15/98	34/98	25/98	25/98

Table 4.1-2 (continue)

Name of Station Station ID No.	River	River Bank	Distance from the Mouth (km)	Number of Years of Records and the Latest Year of Record or Each of the Following Categories of Parameters						
				Water Discharge	Susp. Sed. Discharge	N	P	BOD_5 or COD	Heavy Metals	Other Toxics
Grdelica 47540	South Morava	right	163.0			31/98	15/98	31/98	25/98	25/98
Mojsinje 47590	South Morava	right	18.1			34/98	15/98	34/98	25/98	25/98
Doljevac 47890	Toplica	right	3.0			31/98	15/98	31/98	25/98	25/98
Dimitrovgrad TBS 47910	Nisava	right	142.0			34/98	15/98	34/98	25/98	25/98
Bela Palanka 47950	Nisava	right	70.7			34/98	15/98	34/98	25/98	25/98
Niš 47990	Nisava	right	21.4			34/98	15/98	34/98	24/98	24/98
Petačnica TBS (downst. Jablanica r.) 47907	Jerma	right	21.5			31/98	15/98	31/98	25/98	25/98

BASIC HYDRAULIC DATA FOR THE DANUBE RIVER

Table : 4.4.2. - 1
GS "Bezdan", r. km 1425.5

H (cm)	F (m²)	B (m)	Q(m³/s)
-60	1679.0	355.0	813
-50	1714.5	357.8	848
-40	1750.9	362.2	883
-30	1787.3	365.5	919
-20	1824.0	369.1	957
-10	1861.1	372.0	995
0	1898.4	374.8	1035
10	1936.0	377.7	1075
20	1973.9	380.6	1116
30	2012.2	383.6	1159
40	2050.7	388.3	1202
50	2089.8	392.5	1246
60	2129.3	398.2	1291
70	2169.9	413.3	1338
80	2211.4	417.2	1385
90	2253.3	420.2	1433
100	2295.5	423.2	1483
110	2337.9	424.6	1533
120	2380.4	426.4	1584
130	2423.2	431.3	1636
140	2467.0	445.3	1690
150	2512.2	456.2	1744
160	2557.9	458.1	1799
170	2603.8	459.4	1856
180	2649.8	460.5	1913
190	2695.9	461.8	1972
200	2742.1	463.0	2031
210	2788.5	464.0	2092
220	2834.9	465.2	2153
230	2881.5	466.4	2216
240	2928.3	469.7	2279
250	2975.4	471.5	2344
260	3022.6	471.7	2409
270	3069.8	472.0	2476
280	3117.0	472.3	2544
290	3164.2	472.5	2612
300	3211.5	473.1	2682
310	3258.9	474.5	2753
320	3306.4	476.0	2825
330	3354.1	477.5	2898
340	3401.9	479.0	2971
350	3449.9	480.4	3046
360	3498.0	481.9	3123
370	3546.2	483.4	3200
380	3594.7	484.9	3278
390	3643.2	486.4	3357
400	3691.9	487.8	3437
410	3740.8	489.3	3519
420	3789.8	490.8	3601
430	3839.0	492.3	3684
440	3888.3	495.2	3769
450	3938.0	499.2	3855
460	3988.1	503.1	3941
470	4038.6	507.0	4029
480	4089.5	510.9	4118

Table : 4.4.2. - 2
GS "Apatin", r. km 1401.5

H(cm)	F (m²)	B (m)
-100	1936.9	436.3
-90	1980.5	437.0
-80	2024.3	437.6
-70	2068.1	438.6
-60	2112.1	440.1
-50	2156.3	445.3
-40	2200.9	447.6
-30	2245.7	448.8
-20	2290.7	450.0
-10	2335.8	451.4
0	2381.0	452.9
10	2426.3	454.4
20	2471.9	455.9
30	2517.6	460.0
40	2563.8	464.9
50	2610.5	468.9
60	2657.7	475.2
70	2705.5	478.4
80	2753.4	479.8
90	2801.4	481.9
100	2849.7	483.1
110	2898.1	484.2
120	2946.6	485.8
130	2995.2	487.4
140	3044.0	489.0
150	3093.0	490.7
160	3142.2	492.3
170	3191.5	493.9
180	3240.9	495.1
190	3290.5	495.8
200	3340.1	496.5
210	3389.8	497.2
220	3439.5	497.9
230	3489.4	498.5
240	3539.3	500.0
250	3589.4	502.2
260	3639.7	504.0
270	3690.2	505.5
280	3740.8	507.2
290	3791.6	508.9
300	3842.6	510.6
310	3893.7	512.3
320	3945.1	514.0
330	3996.5	515.7
340	4048.2	517.4
350	4100.0	519.1
360	4152.0	520.8
370	4204.2	522.5
380	4256.5	524.2
390	4309.0	525.9
400	4361.7	527.6
410	4414.6	529.3

Table : 4.4.2. - 3
GS "Bogojevo", r. km 1367.0

H(cm)	F (m²)	B (m)	Q(m³/s)
20	1388.0	437.0	1300
30	1432.0	443.5	1345
40	1476.7	450.9	1390
50	1523.4	492.4	1440
60	1575.4	546.3	1490
70	1632.8	593.6	1540
80	1695.2	649.7	1590
90	1762.8	696.0	1645
100	1833.3	712.7	1700
110	1905.2	723.6	1755
120	1978.0	732.3	1810
130	2051.3	734.5	1870
140	2124.9	736.1	1930
150	2198.6	737.7	1995
160	2272.3	738.1	2060
170	2346.2	738.7	2130
180	2420.1	739.8	2200
190	2494.1	740.8	2265
200	2568.3	741.9	2330
210	2642.5	743.0	2400
220	2716.9	744.0	2470
230	2791.3	745.1	2540
240	2865.9	746.1	2610
250	2940.5	747.2	2680
260	3015.3	748.2	2750
270	3091.2	749.3	2830
280	3165.2	750.3	2910
290	3240.2	751.0	2990
300	3315.3	751.6	3070
310	3390.6	752.6	3140
320	3465.9	753.6	3210
330	3541.3	754.6	3290
340	3616.8	755.5	3370
350	3692.4	756.5	3450
360	3768.1	757.5	3530
370	3843.9	758.5	3610
380	3919.8	759.1	3690
390	3995.7	759.7	3770
400	4071.7	760.3	3860
410	4147.8	761.0	3940
420	4223.9	761.6	4030
430	4300.1	762.2	4110
440	4376.3	762.6	4200
450	4452.6	763.0	4280
460	4528.9	763.4	4370
470	4605.3	764.4	4450
480	4681.8	765.6	4540
490			4630
500			4720
510			4810
520			4900
530			4990
540			5080
550			5170
560			5260

Source : Federal Institute of Hydrometheorology

BASIC HYDRAULIC DATA FOR THE DANUBE RIVER

Table : 4.4.2. - 4
GS "Bačka Palanka", r. km : 1301.5

H (cm)	F (m^2)	B (m)	Q (m^3/s)
0	1941.2	420.5	1175
10	1983.4	423.9	1208
20	2026.2	430.4	1243
30	2069.4	433.6	1290
40	2112.9	436.3	1330
50	2156.7	439.9	1380
60	2200.9	444.7	1430
70	2245.4	446.4	1483
80	2290.1	447.6	1540
90	2335.0	448.8	1600
100	2379.9	450.3	1665
110	2425.2	454.2	1725
120	2470.6	454.7	1790
130	2516.1	455.2	1850
140	2561.6	455.7	1925
150	2607.2	456.6	1990
160	2652.9	457.6	2060
170	2698.8	458.7	2134
180	2744.7	459.7	2208
190	2790.7	460.7	2283
200	2836.8	461.8	2355
210	2883.1	462.8	2430
220	2929.4	463.8	2505
230	2975.8	464.9	2584
240	3022.4	465.9	2667
250	3069.0	466.9	2745
260	3115.8	468.0	2825
270	3162.6	469.0	2910
280	3209.6	470.1	2995
290	3256.6	471.1	3080
300	3303.8	472.1	3170
310	3351.0	473.2	3258
320	3398.4	474.2	3350
330	3445.9	475.1	3440
340	3493.4	476.1	3530
350	3541.1	477.1	3620
360	3588.9	478.1	3720
370	3636.7	479.1	3815
380	3684.7	480.1	3910
390	3732.7	481.1	4005
400	3780.9	482.0	4105
410	3829.1	483.0	4210
420	3877.5	484.0	4310
430	3925.9	485.0	4410
440	3974.8	494.0	4515
450	4024.7	504.0	4620
460	4075.5	510.4	4720
470	4126.8	515.4	4835
480	4178.6	520.4	4950
490	4230.9	525.4	5050
500	4283.7	530.4	5170

Table : 4.4.2. - 5
GS "Novi Sad", r. km: 1255.5

H (cm)	F (m^2)	B (m)	Q (m^3/s)
60	2306.4	268.8	1334
70	2333.5	271.6	1404
80	2360.7	272.8	1475
90	2388.0	274.2	1546
100	2415.5	274.6	1617
110	2442.9	275.1	1689
120	2470.5	275.7	1761
130	2498.1	276.0	1834
140	2525.7	276.3	1908
150	2553.3	276.6	1982
160	2581.0	277.0	2057
170	2608.8	278.0	2133
180	2636.6	279.0	2209
190	2664.6	280.0	2286
200	2692.6	281.2	2364
210	2720.7	282.0	2443
220	2749.0	282.8	2523
230	2777.3	283.6	2603
240	2805.7	284.3	2685
250	2834.1	284.7	2767
260	2862.6	285.2	2850
270	2891.2	285.7	2935
280	2919.8	286.1	3021
290	2948.4	286.5	3107
300	2977.1	286.9	3195
310	3005.8	287.3	3284
320	3034.6	287.7	3375
330	3063.3	288.1	3466
340	3092.2	288.5	3559
350	3121.6	288.9	3653
360	3150.0	289.3	3749
370	3178.9	289.8	3846
380	3207.9	290.1	3944
390	3237.0	292.0	4044
400	3266.3	294.3	4146
410	3295.8	294.7	4248
420	3325.3	294.9	4353
430	3354.8	295.0	4459
440	3384.3	295.2	4567
450	3413.8	295.4	4676
460	3443.3	295.6	4788
470	3472.9	295.7	4901
480	3502.5	295.9	5015
490	3532.1	296.1	5132
500	3561.7	296.2	5250
510	3591.3	296.4	5371

Source : Federal Institute of Hydrometheorology

BASIC HYDRAULIC DATA FOR THE DANUBE RIVER

Table : 4.4.2. - 6

GS "Slankamen", r. km: 1215.5

H (cm)	F (m^2)	B (m)
-170	1293.1	494.0
-160	1342.7	498.3
-150	1392.9	505.3
-140	1443.9	514.4
-130	1495.4	515.8
-120	1547.0	517.2
-110	1598.8	518.8
-100	1650.8	520.3
-90	1702.9	521.7
-80	1755.1	523.1
-70	1807.5	524.9
-60	1860.1	526.6
-50	1913.0	530.4
-40	1966.1	532.7
-30	2019.5	535.1
-20	2073.1	537.3
-10	2127.0	539.3
0	2181.0	541.3
10	2235.2	543.3
20	2289.7	545.8
30	2344.4	548.3
40	2399.3	551.6
50	2454.7	555.7
60	2510.5	560.2
70	2566.8	565.8
80	2623.7	571.3
90	2681.0	575.8
100	2738.8	579.6
110	2796.9	583.2
120	2855.5	589.6
130	2915.0	601.5
140	2976.2	625.9
150	3039.0	627.6
160	3101.8	628.2
170	3164.6	628.9
180	3227.6	631.1
190	3290.8	632.2
200	3354.0	632.9
210	3417.3	633.6
220	3480.8	634.4
230	3544.3	636.3
240	3608.0	638.8
250	3672.1	642.1
260	3736.4	644.5
270	3800.9	646.5
280	3865.7	648.3
290	3930.6	650.1
300	3995.7	651.9
310	4061.0	653.8
320	4126.4	655.6
330	4192.1	657.4

Table : 4.4.2. - 7

GS "Zemun", r. km: 1174.0

H (cm)	F (m^2)	B (m)
-130	2235.5	628.2
-120	2298.4	629.4
-110	2361.4	630.5
-100	2424.5	631.3
-90	2487.6	632.1
-80	2550.9	632.9
-70	2614.2	633.8
-60	2677.6	634.6
-50	2741.1	635.3
-40	2804.7	636.0
-30	2868.3	636.8
-20	2932.0	637.7
-10	2995.8	638.5
0	3059.7	638.8
10	3123.6	639.2
20	3187.6	639.5
30	3251.5	640.1
40	3315.6	640.6
50	3379.6	641.0
60	3443.8	641.6
70	3508.0	642.9
80	3572.3	644.2
90	3636.9	646.5
100	3701.6	646.9
110	3766.3	647.6
120	3831.2	650.4
130	3896.2	650.6
140	3961.3	650.9
150	4026.5	652.0
160	4091.7	652.7
170	4157.0	653.4
180	4222.4	654.1
190	4287.8	655.2
200	4353.4	656.6
210	4419.2	658.1
220	4485.0	659.7
230	4551.1	661.2
240	4617.3	662.8
250	4683.6	664.6
260	4750.1	665.3

Source : Federal Institute of Hydrometheorology

Table 4.4.2. - 8 : AVERAGE SECTION VELOCITIES OF DANUBE RIVER
(Stretch D - 6 : Belgrade-Timok River Mouth)

Section : D - 6-1
Name : **Pančevo**

Q (m^3/s)	V (m/s)
0	0.00
3000	0.41
6000	0.69
9000	0.97
12000	1.14

Section : D - 6-2
Name : **Morava**

Q (m^3/s)	V (m/s)
0	0.00
3000	0.35
6000	0.65
9000	0.92
12000	1.17

Section : D - 6-3
Name : **Nera**

Q (m^3/s)	V (m/s)
0	0.00
3000	0.32
6000	0.60
9000	0.77
12000	0.93

Section : D - 6-4
Name : **Golubac**

Q (m^3/s)	V (m/s)
0	0.00
3000	0.24
6000	0.47
9000	0.70
12000	1.04

Section : D - 6-5
Name : **Dobra**

Q (m^3/s)	V (m/s)
0	0.00
3000	0.29
6000	0.64
9000	0.98
12000	1.44

Section : D - 6-6
Name : **Milanovac**

Q (m^3/s)	V (m/s)
0	0.00
3000	0.20
6000	0.43
9000	0.65
12000	0.94

Section : D - 6-7
Name : **Dam I**

Q (m^3/s)	V (m/s)
0	0.00
3000	0.21
6000	0.29
9000	0.49
12000	0.70

Section : D - 6-8
Name : **Kladovo**

Q (m^3/s)	V (m/s)
0	0.00
3000	0.45
6000	0.88
9000	1.12
12000	1.20

Section : D - 6-9
Name : **Milutinovac**

Q (m^3/s)	V (m/s)
0	0.00
3000	0.36
6000	0.67
9000	1.04
12000	1.25

Section : D – 6-10
Name : **Dam II**

Q (m^3/s)	V (m/s)
0	0.00
3000	0.27
6000	0.51
9000	0.81
12000	1.10

Section : D - 6-11
Name : **Timok**

Q (m^3/s)	V (m/s)
0	0.00
3000	0.75
6000	0.93
9000	1.04
12000	1.12

Source : Federal Institute of Hydrometheorology

Note : See Chapter 4.4.2 and Figures 4.4.2.-1 to 4.4.2.-7

BASIC HYDRAULIC DATA FOR THE SAVA RIVER

Table : 4.4.2. -9
GS "**Sremska Mitrovica**", r. km : **136.0**

H (cm)	F (m^2)	B (m)	Q (m^3/s)
0	1432.8	201.5	180
10	1453.0	201.9	220
20	1473.2	202.3	260
30	1493.5	202.7	300
40	1513.8	203.1	350
50	1534.1	203.5	390
60	1554.5	203.9	430
70	1574.9	204.3	470
80	1595.4	204.7	520
90	1615.9	205.1	560
100	1636.4	205.5	600
110	1657.0	205.9	650
120	1677.6	206.3	690
130	1698.2	206.7	730
140	1718.9	207.1	780
150	1739.7	207.5	830
160	1760.4	207.9	880
170	1781.2	208.3	930
180	1802.1	208.7	980
190	1823.0	209.1	1030
200	1843.9	209.5	1080
210	1864.9	209.9	1130
220	1885.9	210.3	1180
230	1907.0	210.7	1230
240	1928.1	211.1	1290
250	1949.2	211.5	1340
260	1970.4	211.9	1400
270	1991.6	212.7	1450
280	2012.9	213.4	1510
290	2034.3	214.1	1560
300	2055.7	214.8	1620
310	2077.2	215.6	1680
320	2098.8	216.3	1740
330	2120.5	217.0	1800
340	2142.2	217.8	1860
350	2164.1	218.5	1920
360	2185.9	219.2	1980
370	2207.9	219.9	2040
380	2230.0	220.7	2100
390	2252.1	222.3	2170
400	2274.4	223.9	2240
410	2296.9	225.6	2300
420	2319.5	227.2	2370
430	2342.3	228.9	2440
440	2365.3	230.5	2510
450	2388.4	232.2	2580
460	2411.7	233.8	2650
470	2435.2	235.5	2720
480	2458.8	237.1	2790
490	2482.6	238.8	2860
500	2506.6	240.4	2930
510	2530.7	241.3	3000
520	2554.8	242.2	3080
530	2579.1	243.1	3160
540	2603.4	244.0	3230
550	2627.9	244.9	3300
560	2652.4	245.8	3380
570	2677.0	246.7	3460
580	2701.7	247.5	3540
590	2726.5	248.4	3620
600	2751.4	249.3	3700
610	2776.4	250.2	3780
620	2801.5	251.1	3860
630	2826.6	252.0	3950
640	2851.9	252.9	4040

Source : Federal Institute of Hydrometheorology

BASIC HYDRAULIC DATA FOR THE SAVA RIVER

Table : 4.4.2. - 10

GS "**Šabac**", r. km: 102.6

H (cm)	F (m^2)	B (m)
-620	757.4	247.6
-610	782.3	251.0
-600	807.6	254.8
-590	833.3	259.5
-580	859.6	266.0
-570	886.4	270.2
-560	913.6	273.0
-550	941.0	275.6
-540	968.7	278.2
-530	996.7	280.8
-520	1024.9	283.7
-510	1053.4	286.7
-500	1082.2	289.7
-490	1111.4	292.8
-480	1140.8	295.8
-470	1170.5	298.6
-460	1200.5	301.4
-450	1230.8	304.0
-440	1261.3	306.7
-430	1292.1	309.2
-420	1323.2	311.2
-410	1354.4	313.5
-400	1385.9	316.5
-390	1417.7	319.5
-380	1449.8	324.0
-370	1482.5	329.3
-360	1515.6	332.9
-350	1549.0	334.6
-340	1582.6	336.5
-330	1616.3	338.8
-320	1650.3	341.5
-310	1684.6	344.1
-300	1719.2	346.5
-290	1753.9	347.5
-280	1788.7	348.6
-270	1823.6	350.1
-260	1858.7	351.8
-250	1894.0	354.3
-240	1929.5	356.2
-230	1965.2	358.0
-220	2001.1	359.9
-200	2069.6	371.4
-190	2107.0	376.2
-180	2144.9	381.0
-170	2183.2	385.7
-160	2222.0	390.5
-150	2261.3	395.3
-140	2301.1	400.1
-130	2341.3	404.8
-120	2382.0	409.6
-110	2423.2	414.4
-100	2464.9	419.2
-90	2507.1	423.9
-80	2549.7	428.7
-70	2592.8	433.5
-60	2636.4	438.3
-50	2680.4	443.0
-40	2725.0	447.8
-30	2770.0	452.6
-20	2815.5	457.4
-10	2861.5	462.1
0	2907.9	466.9
10	2954.9	471.7
20	3002.3	476.5
30	3050.2	481.2
40	3098.5	486.0
50	3147.4	490.8
60	3196.7	495.6
70	3246.5	500.3
80	3296.8	505.1
90	3347.5	509.9
100	3398.7	514.7
110	3450.4	519.4
120	3502.6	524.2
130	3555.3	529.0
140	3608.4	533.8
150	3662.0	538.5
160	3716.1	543.3
170	3770.7	548.1
180	3825.8	552.9
190	3881.3	557.7
200	3937.3	562.4
210	3993.8	567.2
220	4050.7	572.0
230	4108.2	576.8
240	4166.1	581.4
250	4224.4	584.5
260	4283.0	587.7
270	4341.9	590.9
280	4401.2	594.1
290	4460.7	597.2
300	4520.6	600.4
310	4580.8	603.6
320	4641.3	606.7
330	4702.1	609.9
340	4763.3	613.1
350	4824.8	616.2
360	4886.5	619.4
370	4948.6	622.6
380	5011.1	625.7
390	5073.8	628.9
400	5136.8	632.1
410	5200.2	635.2
420	5263.9	638.4
430	5327.9	641.6
440	5392.2	644.8
450	5456.8	647.9
460	5521.8	651.1
470	5587.1	654.3
480	5652.6	657.4
490	5718.6	660.6
500	5784.8	663.8
510	5851.3	667.0
520	5918.2	670.1
530	5985.3	673.3
540	6052.8	676.4
550	6120.6	679.6
560	6188.7	682.8
570	6257.2	686.0
580	6325.9	689.1
590	6395.0	692.3
600	6464.4	695.5

Source : Federal Institute of Hydrometheorology

BASIC HYDRAULIC DATA FOR THE SAVA RIVER

Table : 4.4.2. - 11

GS "**Beograd**", r. km 0.5

H (cm)	**F** (m^2)	**B** (m)
-290	1527.5	380.4
-280	1565.6	382.3
-270	1604.0	391.5
-260	1643.6	399.9
-250	1683.9	405.8
-240	1725.0	416.4
-230	1767.7	433.6
-220	1811.4	439.9
-210	1855.6	444.0
-200	1900.4	450.8
-190	1945.7	455.0
-180	1991.5	461.1
-170	2037.8	465.9
-160	2084.7	471.0
-150	2132.2	480.1
-140	2180.5	485.9
-130	2229.4	491.8
-120	2279.3	507.6
-110	2331.4	534.6
-100	2385.4	544.3
-90	2440.0	547.7
-80	2494.9	550.6
-70	2551.0	574.9
-60	2609.4	602.4
-50	2670.9	630.0
-40	2734.7	648.6
-30	2800.9	667.9
-20	2868.2	675.5
-10	2936.1	680.7
0	3004.6	683.7
10	3072.9	690.1
20	3142.1	695.9
30	3212.2	703.1
40	3282.7	707.5
50	3353.7	712.2
60	3425.0	714.4
70	3496.7	720.0
80	3568.9	723.8
90	3641.4	726.3
100	3714.2	728.4
110	3787.9	744.9
120	3863.5	764.1
130	3940.5	775.0
140	4018.5	788.4
150	4098.2	801.9
160	4178.8	809.1
170	4260.1	817.4
180	4342.1	823.9
190	4424.7	828.4
200	4507.6	830.4
210	4591.2	843.2
220	4675.7	845.5
230	4760.3	846.4
240	4845.0	847.4
250	4929.8	848.4
260	5014.7	849.4
270	5099.6	850.4
280	5184.7	851.3
290	5269.9	852.3
300	5355.2	853.3
310	5440.6	854.3
320	5526.0	855.2
330	5611.6	856.2
340	5697.3	857.1
350	5783.0	857.5
360	5868.8	857.9
370	5954.6	858.2
380	6040.4	858.6
390	6126.3	859.0
400	6212.2	859.4
410	6298.2	859.8
420	6384.2	860.2
430	6470.3	861.3
440	6556.4	862.6
450	6642.4	862.9

Source : Federal Institute of Hydrometheorology

BASIC HYDRAULIC DATA FOR THE TISA RIVER

Table : 4.4.2. - 12
GS "Senta", r. km : 122

H (cm)	F (m^2)	B (m)
60	992.0	252.3
70	1017.3	252.8
80	1042.6	253.3
90	1067.9	253.9
100	1093.3	254.4
110	1118.8	254.9
120	1144.3	255.4
130	1169.9	255.9
140	1195.5	256.4
150	1221.2	256.9
160	1246.9	257.4
170	1272.7	257.9
180	1298.5	258.5
190	1324.3	259.0
200	1350.3	259.5
210	1376.2	260.0
220	1402.3	260.5
230	1428.3	261.1
240	1454.5	262.1
250	1480.6	263.0
260	1507.1	264.0
270	1533.6	265.0
280	1560.1	265.9
290	1586.7	266.9
300	1613.5	267.9
310	1640.3	268.8
320	1667.2	269.8
200	1350.3	259.5
210	1376.2	260.0
220	1402.3	260.5
230	1428.3	261.1
240	1454.5	262.1
250	1480.6	263.0
260	1507.1	264.0
270	1533.6	265.0
280	1560.1	265.9
290	1586.7	266.9
300	1613.5	267.9
310	1640.3	268.8
320	1667.2	269.8

Note : UG - Upstream of the Gate

Table : 4.4.2. - 13
GS "Novi Bečej" (UG), r. km : 65.2

H (cm)	F (m^2)	B (m)
50	940.3	157.7
60	955.4	163.3
70	972.2	165.6
80	989.0	169.0
90	1005.9	170.1
100	1023.0	171.2
110	1040.1	172.3
120	1057.4	173.8
130	1075.0	176.9
140	1092.7	177.9
150	1110.7	180.8
160	1128.9	181.3
170	1147.0	181.8
180	1165.2	183.9
190	1183.7	185.3
200	1202.3	185.9
210	1220.9	186.6
220	1239.6	187.3
230	1258.3	188.0
240	1277.2	188.8
250	1296.1	189.6
260	1315.1	190.6
270	1334.2	191.6
280	1353.4	192.5
290	1372.7	193.5
300	1392.1	194.5
310	1411.6	195.5
320	1431.2	196.5
330	1450.9	197.5
340	1470.7	198.5
350	1490.6	199.5
360	1510.6	200.0
370	1530.6	200.4
380	1550.7	200.8
390	1570.8	201.2
400	1590.9	201.7
410	1611.1	202.1
420	1631.4	202.5
430	1651.6	202.9
440	1671.9	203.3
450	1692.3	203.8
460	1712.7	204.2
470	1733.1	204.6
480	1753.6	205.0
490	1774.1	205.4
500	1794.7	205.9
510	1815.3	207.9
520	1836.4	212.5
530	1857.8	215.6
540	1879.4	216.3
550	1901.1	217.1
560	1922.8	218.7
570	1944.8	220.8
580	1967.0	222.2
590	1989.2	223.0

Source : Federal Institute of Hydrometheorology

BASIC HYDRAULIC DATA FOR THE TISA RIVER

Table : 4.4.2. - 14

GS "Novi Bečej" (DG), r. km: 64.8

H(cm)	F (m²)	B (m)
0	814.3	230.6
10	837.4	231.3
20	860.6	232.0
30	883.8	232.9
40	907.1	233.5
50	930.5	234.1
60	954.0	234.8
70	977.5	235.4
80	1001.0	235.9
90	1024.7	236.5
100	1048.3	237.1
110	1072.1	237.6
120	1095.9	238.2
130	1119.7	238.6
140	1143.6	239.1
150	1167.5	239.5
160	1191.5	240.2
170	1215.6	240.9
180	1239.7	241.2
190	1263.8	241.8
200	1288.0	242.4
210	1312.3	243.0
220	1336.6	243.6
230	1361.0	244.6
240	1385.5	245.6
250	1410.1	246.4
260	1434.8	247.1
270	1459.6	247.9
280	1484.4	248.6

Note : DG - Downstream of the Gate

Table : 4.4.2. - 15

GS "Titel", r. km: 9.8

H(cm)	F (m²)	B (m)
200	1363.7	206.6
210	1384.4	207.6
220	1405.3	209.4
230	1426.2	210.1
240	1447.3	211.0
250	1468.4	212.0
260	1489.7	213.0
270	1511.0	214.0
280	1532.5	215.0
290	1554.0	216.0
300	1575.7	217.0
310	1597.4	218.0
320	1619.3	219.0
330	1641.3	220.1
340	1663.3	221.1
350	1685.5	221.7
360	1707.7	222.1
370	1729.9	222.5
380	1752.2	223.0
390	1774.5	223.4
400	1796.8	223.8
410	1819.2	224.2
420	1841.7	224.7
430	1864.2	225.1
440	1886.7	225.5
450	1909.3	226.0
460	1931.9	226.4
470	1954.6	227.6
480	1977.7	236.3
490	2001.6	239.7
500	2025.6	240.8
510	2049.8	242.0
520	2074.0	243.2
530	2098.4	245.4

Source : Federal Institute of Hydrometheorology