DANUBE POLLUTION REDUCTION PROGRAMME

NATIONAL REVIEWS 1998
CROATIA

EXECUTIVE SUMMARY

State Water Directorate
State Directorate for the Protection of Nature and Environment

in cooperation with the

Programme Coordination Unit
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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 where 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 Review data which is 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 Review 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 **Croatian National Review** was prepared under the supervision of the Head of Delegation to the Danube River Protection Commission, **Mr. Zeljko Ostojic**, with the support of the Country Programme Coordinator, **Mr. Predrag Sibalic**. The authors of the respective parts of the report are:

- Part A : Social and Economic Analysis: **Mr. Ognjen Caldarovic**
- Part B : Financing Mechanisms: **Ms. Dubravka Mokos**
- Part C : Water Quality: **Ms. Marija Marijanovic**
- Part D : Water Environmental Engineering: **Mr. Silvio Brezak**

The findings, interpretation and conclusions expressed in this publication are entirely those of the authors and should not be attributed in any manner to the UNDP/GEF and its affiliated organizations.

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Vienna – Austria, November 1998

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Executive Summary

The state of the Danube environment in the national context

Croatia is divided into four major geographical areas - in the Panonia area which lies in the Eastern part covering approximately 11.100 km^2 with a median yearly precipitation of 600 to 700 mm. The second part is Middle Croatia, which covers c/a 19.700 km^2 and the regime of precipitation is under the influence of Mediterranean as well as continental part of the country. Median precipitation is between 700 - 900 mm. The third part of the country is the Mediterranean part, which is partly a mountainous area, and partly coastline area. It covers c/a 14.000 km^2 and a median yearly precipitation is c/a 1.000 mm. The fourth area is Middle and Southern Dalmatia, which covers an area of c/a 11.740 km^2 with median yearly precipitation of 1.000 mm or more.

Many settlements and towns as well as industries are located along the Drava river which also contributes to the quality of Drava water as well as to the quality of water of Danube river. Many problems affecting the quality of the Danube river water are listed in the Strategic Action Plan (Strategic Action Plan..., pp. II-III) and are also relevant for Croatia as well: changes of patterns of river flow, pollution of rivers with dangerous substances, municipal and industrial waste, uncontrolled dumping of waste into the river or close to it, many possibilities of pollution of underground waters, agricultural pollution by different farms, irrigation, uses of pesticides and fertilizers as well as by untreated municipal, industrial and individually produced wastewater. Also, the following reasons for deterioration of water resources in Croatia can be mentioned:

- the development of water supply was much higher then the development of sewage systems as well as the treatment of sewage waters;
- the development of economy after 2nd World War was not followed by adequate water management which resulted in many cases by the construction of big industrial capacities on the small rivers and without sewage waters treatment facilities;
- the construction of sewage system was not followed with construction of wastewater treatment facilities;
- environmental protection was very weak, especially in bigger towns;
- industrial wastewaters had been discharged almost regularly directly into rivers or into public sewage systems without any treatment (till recently);

Tourism is not yet very developed along the Danube River in Croatia as well as along its tributaries, but one must bear in mind also its future influence and need for protection of many wetland areas along the Sava, Drava and Danube rivers in Croatia.

There are 4 major wetland areas in the larger Danube catchment area covering the total area of c/a 282.000 ha (Forest areas along Drava river - 2.500 ha, Kopački rit national reserve - 50.000 ha, Alluvial marshy land and wetland along the Sava river - 210.000 ha in which a Nature Park Lonjsko Polje /60.000 ha/ is located, and the Turopolje area, the territory of c/a 20.000 ha of flood area and a natural reserve for drinking water, fish ponds, wild animals, potential recreation, etc.) /Strategic Action Plan..., pp. 30-31/.

Trying to develop a sound environmental policy, Croatia has signed - till now - (1997) several international conventions regulating the duties of each country to comply to the rules and regulations adopted (for example, The Ramsar Convention, Convention on the Biological Diversity and a Convention on the Protection of the River Danube) /Strategic Action Plan..., p.7/.

Population affected by water pollution

In Croatia, a classification and categorization of waters is done on the basis of several legal acts and regulations. It is important to note that the basis for measurements and setting of the standards - for water management - only standards for the recipient are in use and not standards of effluents. It means that quality control and protection of water quality is done through the setting up of certain standards (concentrations) of the effluent which is based on the quality or receiving capacity of the recipient. According to the law regulation on the classification and categorization of surface and underground waters is made - according to the use and level of cleanness of water - 4 categories of water.

Each of these standards has its maximum and minimum set values of concentration of certain substances. According to these 4 categories, all waters in the republic are classified according to their possible use.

According to this classification river Sava is classified into category II except in the part of the river when the river Bosut joins Sava where category III is allowed. Rivers Drava and Danube should be classified in the 2nd category.

Very important problem affecting the quality of drinking water, is relatively high proportion of population, which uses drinking water from private wells where no control of water quality is organized. According to the data, in Croatia 55% of population (1980) is connected to public centralized systems of drinking water provision. In 1991 the situation is improved - 63% of the population is supplied with drinking water from 412 public water provision systems. Another problem is that in these areas inadequate sewage system is in function as well as discharge of wastewater is not properly organized which might cause that a quality of underground water could be in question in some areas.

In the Danube catchment area no bigger health problems or health hazards have been recorded due to the water pollution. Some hydroid epidemic has been reported, but only in case of improper private water wells.

Water quality and impact on ecosystems

Many problems of great importance to the environmental degradation of soil and water are connected with lack of systematic monitoring of water quality. First of all, there is no systematic monitoring, there are no specific data on organic pollutants, collected data in different monitoring locations are not comparable due to their different statistical values, there is no research on the quality of river sediments, there is no monitoring of the transport of pollution along the rivers, the system of grading of quality of surface and/or underground waters is not precise enough, there is no systematic monitoring of underground waters and there is no monitoring of the quality of water of lakes and accumulations, except in the case of the Drava river accumulations. But, nevertheless, monitoring activities in the catchment areas of Sava, Drava and Danube rivers in Croatia, in the last 15 years have shown some improvements in the quality of waters, especially in the river Drava as well as on the river Danube.

Hot spot analysis

The Hot spots analyses show that SAP nominated Hot Spots still exist. The reason for this is the situation in the country within last few years (war, economical transition), when the investment in water pollution protection project was very low or practically did not exist. Also because of this situation the producing level of industry fell also like discharging of wastewater. In last few years there was, because of war, the big migration of the people from directly war affected area in area which was not directly affected by war and this cause the rash growth of population in some cities. All this lead to great changes in producing of wastewater. For example in Zagreb the ratio of

inhabitants producing wastewater and industry is 1:1 with growth trend of inhabitant pollution. There is expectation that in other cities is the similar situation. Hot spot analysis show that existing Hot Spots can not be deleted from the lists because of discharging the big pollution load, impact on sensitive downstream areas, and "small" recipient. However in last few years there were no big changes, in many cases, in building of the treatment plants, or improvement of producing technology or other improvements for reduction of pollution. Therefor existing hot spots can not be deleted from the list. Furthermore there are no official plans to close them. In contrary there is attitude for reviving production. On the list there has been an addition of hot spots because the pollution load is bigger then some existing hot spots.

Actual foreseen pollution reduction measures

The water protection from pollution in Croatia is carried out in order to protect the environment, lives and health of people, and to provide the use of water for different purposes. The water pollution control is conducted through monitoring of water quality and the sources of pollution. Furthermore, the actions such as prevention, restriction and even prohibition of activities which may have the negative impact on water quality and the state of environment also play important role to protect and improve the quality of water and environment itself.

The water protection in Croatia is conducted according to the State Plan for Water Protection from Pollution. The main aim of the State Plan for Water Protection from Pollution is to ensure the water management based on the principle of integrity of water system and on the principle of sustainable development. Other defined principles in this Plan are the principle of prevention, the principle of monitoring of pollution, the principle of use of the best suitable technologies, and the principle "polluters pay". Finally, the document emphasizes the need for constant exchange of information about the water quality with neighboring countries.

The State Plan describes the measures for water pollution control, the targets of the measures and schedule for implementation of these measures.

The targets of the measures are the following:

- preservation of the water resources which are still clean, as such upstream parts of rivers and groundwater
- stopping the further degradation of water quality, which can be achieved through the implementation of the measures in medium and long-term periods;
- restoration or removals of the sources of pollution are priorities as on existing or planned drinking water sources, as on other places where the water is used for different purposes (industry, agriculture, fishery, recreation, etc.).
- strengthening of the monitoring of the sources of pollution and possible accidents is priority task in short-term period. By strengthening the monitoring it will be possible to make the database for water pollution control and accidental emergency warning system.

Measures for water protection from pollution can be divided into administrative measures, and measures for conservation of water quality.

National targets and instruments for reduction of water pollution are defined by Water Act (1995) and by numerous other technical regulations.

Planned projects and investment portfolio

There are 64 projects recommended as measures for reduction of water pollution. Two of them are non-structural projects, whereas all others are structural projects. The total investment costs are estimated at cca. 664 millions US$. The summary of number of recommended projects takes into account the type of projects and main river basins in Croatia

With respect to large damages to water sector facilities during the war, so far the investments in major water sector projects have dealt with reconstruction of war damages, mainly through the loans by IBRD, Croatian Bank for Reconstruction and Development and loans from Kreditanstalt fur Wiederbau and through "Hermes" insurance.

1. Description of the State of the Danube Environment

Water resources

The Danube River is not the longest but is definitely the biggest river in Croatia. River Danube in Croatia covers the area of 2.523 km^2 or only 0.3% of the total area of the river in its total length. It goes through Croatia in the total length of 188 km and it does not have the same importance as a water resource as do have Drava and Sava rivers. Major tributaries to the river Danube in Croatia are:

1. River Vuka (1.120 km^2)
2. River Baranjska Karašica (1.160 km^2).

There are just a few settlements along the Danube river and only two major towns (Vukovar and Ilok), the area is populated mostly by agricultural population who depend on the water as well as who produce wastewater and influence the quality of Danube water in general. From the other side, it also means that many problems connected with Danube River system are coming through the water of the river from the countries lying upstream. It especially counts for different type of pollution, water degradation and other non-controlled situations, which could happen in the countries upstream.

Apart from this situation, the river Danube has some major tributaries in Croatia. One, the biggest and longest river in the country, Sava , with the total length of 518 kilometers and covering a total territory in Croatia of 25.100 km^2, is a major contributor to the quality of waters of the Danube river itself due to the highest number of settlements, industries and tributaries. Main tributaries of Sava River are:

1. Sutla river, with 118 km^2 (89 km. length in Croatia)
2. Krapina river, with 1.123 km^2 (75 km)
3. Trebež, Lonja and Ilova rivers with 5.944 km^2 (133)
4. Orljava river with 1.944 km^2 (89 km)
5. Bosut river with 2.572 km^2 (151)
6. Kupa river with 8.225 km^2 (116)
7. Sunja river with 470 km^2 (62)
8. Una river with 1.100 km^2 (107)

Major problems facing water management and water demand in the Slavonia region of Sava catchment area is that only c/a 25% of the inhabitants are connected to the public supply system of drinking water and that the demand for water is high and water resources are limited. It means that more investigation for more water resources must be organized. In the middle and western part of the Sava catchment area, especially in Zagreb and in its vicinity, there is a heavy water demand. On average, c/a 75% of the demand is satisfied by the public water supply, even the ratio ranges between 40% to 90%. Problems related to the water supply must be solved in the combination of regional and central public water systems with the limited use of local water systems as a transitory solution.

The other major tributary to Danube in Croatia - the river Drava - is not a national river, but also comes from the countries located to the North and West of Croatia. The total length of river Drava in Croatia is 323 kilometers, with the total area of 6.888 km^2. Major tributaries of Drava River in Croatia are:

1. Mura river, 508 km^2
2. Plitvica, 321 km^2
3. Bednja 592 km^2

4. Bistra, 397 km^2
5. Kopanjek, 415 km^2
6. Županjski kanal, 675 km^2
7. Karašica, 1.033 km^2
8. Vučica, 1.337 km^2

Major problems facing water supply in the catchment areas of Drava and Danube rivers are that only (on average) 53% of the population is supplied with public water supply system which means that the rest of population uses water from its own wells as does industry. Due to the fact that raw water of Drava and Danube rivers could not be used as a good solution for supply of drinking water, it means that more investigation of the underground waters in this area must be organized.

River Sava is used as a water resource for drinking for thousands of people living along the river or nearby, as well as rivers Drava and Danube (see later the data on population living along all three catchment areas). The waters from rivers are also used for many industries, agricultural needs, fishponds and to a lesser extent for other purposes (for, recreational tourism, for example).

It is estimated that 12% of the total water reserves in Croatia belongs to the underground waters but the significance of that source is very important which can be shown by the fact that more then 90% of all cities (settlements) use underground water for drinking purposes. Generally, the quality of underground waters is rather good, especially in comparison with other European countries which means that this is a very important resource for Croatia. But, due to the constant degradation of underground waters, especially in and around bigger cities (the biggest consumers of underground water in Croatia are Zagreb /Sava/, Osijek /Drava/, Vukovar /Danube/, Varaždin and Koprivnica /Drava/) and settlements as major concentration of industries as well as population where the pollution is the highest, water reserves in karstic systems of the country must also be taken into account. The biggest consumers of surface waters for drinking purposes are Osijek (partly - Drava river), Vukovar (Danube) and Sisak (Kupa river).

River monitoring show slight improvement on all three river basins as well as on other river basins in Croatia during last ten years which means that in the total catchment Danube area (basin area) the water quality had been substantially improved during last 15 years.

Eco – systems and biological resources

The catchment areas of Drava, Sava a Danube are extremely biologically rich. This is and area with many animal and plant sorts, rich in soil and of a great biodiversity. Many eco-systems are still "untouched", especially in the national parks and reserves. Some eco-systems are endangered by the human impact, but the whole area is still an ecological resource. The efficient organization of environmental protection of all three catchment areas will be a good basis for further promotion bio-diversity and sustainability of many eco-systems there.

Human impact and key issues of environmental degradation due to water pollution

Key issues in environmental degradation. Major reasons for pollution of the Danube system waters are continuous discharge of wastewater, waste disposal, use of pesticides and manure on agricultural fields, erosion, aerial pollution, accidents and thermal pollution (Nuclear power plant "Krško", and thermo power electric stations Sisak and Zagreb).

Human impact. Many problems affecting the quality of the Danube river water are the result of human activities: changes of patterns of river flow, pollution of rivers with dangerous substances, municipal and industrial waste, uncontrolled dumping of waste into the river or close to it, many possibilities of pollution of underground waters, agricultural pollution by different farms, irrigation, uses of pesticides and fertilizers as well as by untreated municipal, industrial and individually

produced wastewater. Also, uncontrolled dumping of waste into rivers and on irregular dumping places, discharge of sewage waters without or with only primary treatment directly into rivers, use of river waters for irrigation of agricultural fields, discharge of partially treated or not treated wastewater from agricultural farms, transport of crude or refined oil or other dangerous substances on rivers, the increase of number of population living in the catchment areas which means the increase in the production of waste and wastewater.

Many problems of great importance to the environmental degradation of soil and water are connected also with lack of systematic monitoring of water quality. First of all, there is no systematic monitoring, there are no specific data on organic pollutants, collected data in different monitoring locations are not comparable due to their different statistical values, there is no research on the quality of river sediments, there is no monitoring of the transport of pollution along the rivers, the system of grading of quality of surface and/or underground waters is not precise enough, there is no systematic monitoring of underground waters and there is no monitoring of the quality of water of lakes and accumulations, except in the case of the Drava river accumulations. Several important reasons for environmental degradation can be mentioned here:

1. The development of water management was much faster then the development of sewage systems and wastewater treatment facilities;
2. Fast economic development after 2nd World War was not followed by the adequate water management which resulted by the construction of big industrial enterprises along small rivers or streams and without facilities for wastewater treatment;
3. The construction of sewage systems was not followed by the construction of adequate facilities for wastewater treatment;
4. Environmental protection was very weak, especially in cities and in the sector of economy;
5. Until recently, industrial wastewater had been discharged without adequate treatment into the systems of public sewage or directly into river streams;
6. Water is cheap so water savings is not stimulated which - on the other hand - stimulates high hydraulic loads in drainage systems as well as in the facilities for wastewater treatment;
7. Major reasons for low efficiency of systems for wastewater treatment are the following: peak hydraulic loads and high loads of pollution, the removal of sludge from facilities is not satisfactorily solved, there is a lack of professional staff for facilities' maintenance, the firms to run the treatment equipment are not stimulated to organize the proper work of facilities, etc.

But, taking into account the recent trends it could be concluded that a certain improvement of water quality had been gained in the qualities of Drava, Sava and Danube waters. Major reasons are: in the upper streams of the rivers Sava and Drava, in Slovenia and in Austria there has been an improvement in the construction of water protection facilities, and in the countries of Central Europe, and in Croatia, economic recession has been registered.

2. Population Development and Water Sector Relevant Characteristics

Analysis of demographic data and projection of urban and rural population in the Danube catchment areas

Today (1998), Croatia is divided into 20 counties and the major city of Zagreb, which also holds a position of a county as well as two areas with special status. The counties are divided into cities (69 cities) and municipalities (432 municipalities). Today's total population of Croatia is 4.784.265 inhabitants (1991 census), the area of the country is 56.542 km^2 and an average density of population is 85 inhabitants per a km^2. The Danube catchment area consists of Sava catchment area (25.100 km^2 with population of 2.339.341), Drava catchment area (6.888 km^2, and 705.929 inhabitants) and an immediate Danube area (2.416 km^2, and 203.480 inhabitants). So, in the Danube catchment area total population is 3.248.750 and the ratio of urban and rural population is c/a 55%:45%. It is expected that in the country as a whole in the year 2.015, due to the stagnant demographic situation, it will be slightly less inhabitants then today - c/a 4.500.000.

Estimation of actual and future demand for water

It is estimated that 12% of total water reserves in Croatia belongs to the underground waters but the significance of that source is very important which can be shown by the fact that more then 90% of all cities (settlements) use underground water for drinking purposes. The system of public water pipelines is used by 63% of the inhabitants of Croatia. Water consumption is, in the days of maximum consumption - c/a 22 m^3 per second. 55% of the quantity of water was used by the economy (production), and 45% by the population. Surface waters for public pipeline water demand are used the most in the immediate Danube catchment area (85.2%), much less in the Drava catchment area (6.6%) and the least in the Sava catchment area (2.3%). In general, total quantities of water demand from underground waters are realized with 95.8% in the catchment Sava area, 97.3% in the Drava catchment area and only with 4.6% in the immediate Danube catchment area.

Total water demand for the year 2.015 in the Sava catchment area will be 827.750 m^3/day or 9.581 liters per second or 338 liters per an inhabitant per day. In the catchment areas of Drava and Danube, the projection for water demand in the year 2015 is 284.550 m^3/day or 3.293 liters per second or 298 liters of water per an inhabitant per day. Generally, it could be said that underground water in Northern Croatia is of a good quality, even on this territory the biggest number of potential sources of pollution are located. The area is densely populated along big rivers, the settlements are connected with major roads, the biggest industrial capacities are built in this area, and that is the most advanced agricultural area in Croatia. Due to these reasons, the quality of underground water is only in some spots degraded by the higher concentrations of nitrites or by the temporary increase of the concentration of organic dilutes.

Estimation of actual and futures production of wastewater

Total quantity of wastewater which had been in 1996 in Croatia produced by type of producers is the following: households 127.176.000 m^3, activities 137.126.000 $m^{3,}$ public utilities services 6.641.000 m^3 or total of 270.943.000 m^3. Total domestic wastewater production per capita in Croatia was in 1996 c/a 56,566 m^3 of water, and in major cities in Croatia with a total number of 1.639.7272 inhabitants a yearly total wastewater production of 187.360.059 m^3 or 114,3 m^3 per inhabitant per year. Total discharge of wastewater from public sewage system in 1996 for Croatia is: I. Unpurified water - 212.934.000 m^3 and out of it into the Black Sea watershed (catchment areas of Danube, Sava and Drava) 148.122.000 m^3; II. Purified water 58.009.000 m^3 and out of it into Black Sea watershed 31.594.000 m^3 which means a total of 270.943.000 m^3 of wastewater. It

means that 78.5% of total sewage waters have been discharged into the catchment river systems without purification, and only 21.5% have been purified. It is interesting also to note the major systems of wastewater purification. In 1996 in Croatia mechanically purified were 39.229.000 m^3, biologically 4.971.000 m^3, and combined 13.809.000 m^3, which means a total of 58.009.000 m^3.

Wastewater centralized systems have been built mostly in major cities, centers of municipalities as well as for the supply of bigger enterprises, companies or administrative, cultural or tourist centers. Smaller, especially rural settlements and villages have not been supplied with centralized sewage systems. The existing systems are taking c/a 35% of the total quantity of sewage waters which means that a reduction of the equivalent sewage load is for c/a 25%.

Analysis of health hazards through water pollution and unsanitary conditions

In the Danube catchment area no major health problems or health hazards have been recorded due to water pollution. This is a consequence that most population is connected to the centralized public water supply systems. Some hydroid epidemics have been reported only in the case of improper private water wells.

3. Analysis of Actual and Expected Impact of Economic Activities on Water Demand and Potential Pollution of Aquatic Systems

Industrial activities

Water in needed for industry and mining is taken usually in two ways: (1) directly by the industries (direct use - surface waters or underground waters) or (2) from public pipeline water systems. More precisely, in the Drava and Danube catchment areas raw water is much more used for industrial purposes then in the Sava catchment area. Industrial discharge in most of industrial estates, independent - non-treated or treated wastewater are discharged directly into water. Only a smaller number of factories do have satisfactory wastewater treatment facilities. Many problems arise due to the fact that discharges are sometimes very intensive and sometimes are reduced or even lacking at all - due to the nature of production (for example, treatment of sugar).

Municipal discharges

In the Sava catchment area 920.000 inhabitants or 41% of the total number are connected to the public sewage systems, in the Drava catchment area 361.000 or 41% of the total number and in the immediate Danube catchment area 66.000 or 47.5% of the total number of inhabitants. In the total Danube catchment area it makes a total number of 1.347.500 inhabitants or 41% of the total number. Major cities are supplied with good sewage centralized systems, but even in the major city, Zagreb, not all areas are connected to the system. A special problem consists of the lack of any sewage systems in rural settlements, villages in which a system of public running drinking water exists but there are no sewage systems. In many households, septic containers are used with free discharge into channels and streams nearby which contribute very much to the contamination and pollution of rivers and soil.

Agricultural activities (irrigation, consumption of fertilizer and pesticides...)

Irrigation areas (melioration areas) are located along all three major rivers in Croatia. Along the Sava River they are covering a total area of 25.100 km^2. Agricultural areas are covering 12.052 km^2. which makes 48% of the total areas, forests make 9.158 or 36%, other areas make 11% or 2.670 km^2 and unsuitable areas make 1.220 km^2 or 5% of the total irrigation areas. In the catchment areas of Drava and Danube a total of 9.304 km^2 is classified as irrigation areas, and 61% or 5.709 km^2 is classified as agricultural areas

Solid waste disposals and possible soil and ground water contamination

There are only estimations on the actual number of waste disposal places. So, it is estimated that in 1996 in Croatia a total number of 700 major and mostly not properly regulated waste disposal places are existing and are used by municipal companies. There also c/a 1.300 smaller waste dumps, usually called "wild ones". The total annual quantity of waste for Croatia is 7.720.000 tons or 1.4 tons per inhabitant. 1.350.000 tons per year is classified as municipal waste and c/a 330.600 tons per year is classified as dangerous waste. It is also estimated that only 10% of this waste is properly treated. Only 4 cities in Croatia (only one along the Sava River - Sisak) are properly equipped with waste treatment facilities. Special problem of waste dumping is caused by the disposal of solid waste produced in the wastewater treatment facilities. This solid waste is also disposed on municipal solid waste disposal places, which are not constructed properly, nor well maintained. The surface waters from precipitation get polluted on their way into the underground waters. Moreover, there is a problem of sludge collected in the wastewater treatment facilities. Primary sludge is firstly stabilized and then is disposed in the fields for drying and then taken to the waste dump places as a normal solid waste and municipal waste. Secondary sludge could be also treated but on the installations for wastewater treatment in Croatia this problem is not solved in a satisfactory way for the time being.

4. Analysis of Water Quality Data and description of Environmental Impact on Ecosystems and Human Quality of Life

Water quality data critical to the transboundary analysis (Danube Water Quality Model)

The Danube River and its main tributaries from Croatia, the Sava and the Drava rivers are transboundary and boundary forming rivers with neighboring countries. International monitoring on the Danube and the Drava River was established 30 years ago. It has been changed in the past in frequency of sampling and parameters of determination. National monitoring program of the Drava River tributaries and on the Sava River and its tributaries was established 25 years ago.

TNMN stations from Croatia are: on the Danube river - Borovo - the last monitoring station before the Danube comes out of Croatia, and Batina the first monitoring station after the Danube comes to Croatia; on the Sava river - downstream of Županja like the last monitoring station in Croatia, Jasenovac (upstream of confluence with the Una river) and Jesenice - the first monitoring stations after the Sava comes to Croatia. TNMN stations on the Drava river are the following: Donji Miholjac, Botovo - the boundary stations with Hungary and Varaždin - the first stations after Drava comes to Croatia.

Monitoring on TNMN stations in Croatia includes COD-Cr, total phosphorus (or its fractions), total nitrogen (or its fractions), DOC, oil and heavy metals. Some pesticides have been determined on the Drava and the Danube from this year.

Monitoring was discontinued on the Danube River, and at stations Jasenovac on the Sava River, during the war. It has been continued on the Sava River in 1996, on the Danube at Borovo last year, and at Batina.

Concentrations and loads of nutrients and other pollutants in the Danube River and its tributaries

Available data from existing monitoring have been annualized from 1994 to 1997 at TNMN stations from Croatia. Results of analysis of concentration and loads have been presented on the Table 1.

Concentrations of COD-Cr and nutrients have been presented with annual mean value, concentrations of oil and heavy metals with annual maximum value, and loads have been calculated from annually mean value of concentrations and annual mean value of river flow.

It has been evident from the Table 1, that there is no uniform monitoring at TNMN stations from Croatia. At monitoring stations Danube - Borovo only COD-Cr, orthophosphate and anorganic nitrogen (what means sum of ammonium, nitrite and nitrate) have been determined, at monitoring stations on the Sava river there is no uniform monitoring, so there is no data for COD-Cr at monitoring stations Jasenovac, but there is data of total phosphorus only at that monitoring stations on the Sava river. There is uniformity in monitoring on the TNMN stations at the Drava River from 1997 in determination of nutrients and heavy metals, but there is no data for river flow at Varaždin.

There is evidence that pollution of the Danube River with organic pollutants and nutrients has been somewhat higher than at the Drava River, and lower than at the Sava River at closest station with their confluence with Danube. Organic pollution has increased along river flow of Sava, and nutrients too. That is a result of discharge of industrial and municipal wastewater into Sava without of pretreatment, and agricultural productions in that region with uses fertilizer, and confluence with tributaries from Croatia and Bosnia and Herzegovina. The extreme pollution with oil was determined at Sava - Jasenovac in 1997. Pollution of the Drava River with organic pollutants has

increased from Varaždin to Botovo, which is the result of confluence with the Mura River and discharge of wastewater and agricultural activities. There is similar pollution with organic pollutants and nutrients at Botovo and Donji Miholjac. Pollution with oil and heavy metals on the Drava River are at same concentration level for TNMN stations in that period.

Pollution with organic pollutants and nutrients, and their loads were at similar level from 1994 to 1996. There is some evident decreasing in concentration and loads of organic pollutants and nutrients in 1997 at all TNMN stations on the Sava and Drava Rivers, which could be result of reduction in industrial and agricultural production last year.

Transboundary effects of pollution

The main problem of pollution of tributaries of the Danube from Croatia is pollution with nutrients, especially on the Sava River downstream of Županja.

Concentration of heavy metals could have negative effects to ecosystem in the Drava River. Water of the Drava and the Sava River could have negative impact on ground water, especially if it is near river channel and used for water supply and irrigation.

For detailed analysis of transboundary impact there is a lack of data on specific organic pollutants - pesticide and herbicide which are used in that region in agricultural production, and data of toxic heavy metals on the Sava River.

Table 1. Concentrations and loads of some pollutants at TNMN stations on the Danube, Sava and Drava rivers

PARAMETERS	DANUBE – Borovo			
	1994	**1995**	**1996**	**1997**
COD-Cr (mgO2/l)	-	-	-	11,4
Orthophosphate (mg/l)	-	-	-	0,32
Anorganic N (mg/l)	-	-	-	1,92
PARAMETERS	**SAVA – Županja**			
	1994	**1995**	**1996**	**1997**
COD-Cr (mgO2/l)	30	26	25	26
Orthophosphate (mg/l)	0,52	0,41	0,47	0,28
Total N (mg/l)	4,16	3,33	3,19	4,00
Oil (mg/l)	-	-	0,176	-
Load COD (tO2/yr)	-	1 123 950	1 031 000	856 010
Load ortophosph. (t/yr.)	-	15 237	18 570	9 300
Load total N (t/yr.)	-	124 680	126 650	131 660

PARAMETERS	**SAVA – Jasenovac**			
	1994	**1995**	**1996**	**1997**
Orthophosphate (mg/l)			0,35	0,50
Total P (mg/l)	-	-	0,18	0,23
Total N (mg/l)	-	-	2,12	2,39
Oil (mg/l)			0,100	2,100
Load ortophosph (t/yr.)			9 170	9 750
Load total P (t/yr.)	-	-	4 775	4 500
Load total N (t/yr.)	-	-	83 570	46 660
PARAMETERS	**SAVA – Jesenice**			
	1994	**1995**	**1996**	**1997**
COD-Cr (mgO2/l)	12	13	12	15
Orthophosphate (mg/l)	0,18	0,12	0,06	0,17
Total N (mg/l)	3,07	3,69	3,54	3,50
DOC (mg/l)	2,53	2,04	2,21	2,73
Oil (mg/l)	0,230	0,790	0,620	0,410
Load COD (tO2/yr)	82 610	99 050	113 760	86 800
Load ortophosph (t/yr.)	1 220	946	593	965
Load total N (t/yr.)	21 130	28 080	33 430	20 270
PARAMETERS	**DRAVA - Donji Miholjac**			
	1994	**1995**	**1996**	**1997**
COD-Cr (mgO2/l)	9,8	8,9	10,1	8,4
Ortophpsphate (mg/l)	0,25	0,15	0,15	0,15
Total P (mg/l)	0,10	0,17	0,17	0,12
Total N (mg/l)	2,21	2,59	2,60	1,74
Oil (mg/l)	0,466	0,210	0,170	0,200
Cadmium (µg/l)	2,86	1,22	1,36	1,2
Mercury (µg/l)	0,29	0,28	0,290	0,11
Lead (µg/l)	15,6	19,0	17,9	14,2
Load COD (tO2/yr)	155 145	141 740	193 230	121 060
Load ortophosph. (t/yr.)	3880	2440	2930	2210
Load total P (t/yr.)	1 740	2 710	3 250	1 730
Load total N (t/yr.)	34 990	41 250	49 740	25 080

PARAMETERS	DRAVA – Botovo			
	1994	1995	1996	1997
COD-Cr (mgO2/l)	9,1	9,7	10,3	8,2
Orthophosphate (mg/l)	0,25	0,12	0,12	0,11
Total P (mg/l)	0,10	0,16	0,13	0,10
Total N (mg/l)	2,28	2,61	2,90	1,90
Oil (mg/l)	0,282	0,260	0,170	0,170
Cadmium (µg/l)	2,64	1,26	1,24	1,7
Mercury (µg/l)	0,18	0,80	0,12	0,18
Lead (µg/l)	23,7	19,5	13,5	12,9
Load COD (tO2/yr)	129 140	145 610	173 600	96 400
Load ortophosph. (t/yr.)	3 480	1 840	2 070	1 295
Load total P (t/yr.)	1 420	2 400	2 190	1 120
Load total N (t/yr.)	33 630	39 180	48 880	22 350
PARAMETERS	**DRAVA – Varaždin**			
	1994	**1995**	**1996**	**1997**
COD-Cr (mgO2/l)	3,7	4,0	4,2	3,6
Ortopfospfate (mg/l)	0,09	0,12	0,10	0,04
Total P (mg/l)	-	-	-	0,05
Anorganic N (mg/l)	1,82	2,14	2,05	1,65
Total N (mg/l)	-	-	-	2,10
Cadmium (µg/l)	1,75	1,14	1,21	1,37
Mercury (µg/l)	0,75	0,24	0,12	0,15
Lead (µg/l)	27,3	16,2	12,0	16,6

5. Identification, Description and Ranking of Hot Spots

Identification of Hot Spots has been taken by using the methodology set by the guidelines developed in the review reports.

Main source of information about wastewater control was company Hrvatske vode, where data is being collected.

In Danube river basin area has been chosen the cities which are known to have big industry and great number of habitants, and produce the great amount of pollution load from municipal, industrial or agriculture point source and sensitive area as national parks.

For this points have been collected the available data about wastewater control, wastewater treatment plant, receiving waters, transboundary effects, seasonal variations and other relevant data for years 1997 back through 1994 where is possible.

At first, on the base available data about quantity and quality of discharged wastewater from municipalities, industries and farms, has been made separate list for municipality, agriculture and industries Hot Spots. Each of these lists has been analyzed separately.

The pollution load has been calculated on the base of total discharged quantity of water in year 1997. (it has been estimate on the water supply base or measurement) and years - average of concentration for each indicator.

Municipal hot spots

The SAP nominated Hot Spots has been Belišće, Belje, Čakovec, Karlovac,

Koprivnica, Osijek, Sisak, Slavonski Brod, Varaždin, Vukovar and Zagreb.

These have been the cities with great number of in inhabitants and developed industries.

On the municipal lists of parameters these SAP hot spots have been marked for each parameter and evaluate in comparison with other chosen municipal points.

Updated lists for municipal show that SAP nominated municipal Hot Spots still exist.

There were only problems with municipal system of city Čakovec, Bilje and Vukovar, because of lack of data for last few years. Because of war there was no sampling of wastewater so data not exist for cities Bilje and Vukovar.

Also, with municipal discharge Čakovec there was a problem in calculating the pollution load.

The treatment plant (mechanical - biological) is just finished with construction, and treatment will start with testing work. That is the reason for lack of data for this Hot Spot. The pollution load, for this point, has been calculated on the base of one-day sampling (11.8.97.) during 24 hours. Samples had been taken in time half-hour period - composite sample. After start of work the treatment and same period of monitoring the result of treatment wastewater became sufficient for eventually deleting from the list.

After analysis the list of Municipalities final conclusions are as follow:

- Problems with municipals are more or less the same in whole region, there are the problems with insufficient, not completely constructed sewage systems, with insufficient pretreatment of wastewater of connected industries, and great lack of treatment plant for cleaning the municipal wastewater before discharging.
- Also the existing municipal system has been badly maintained and controlled.
- Problem with water - resistance of sewage system pipes. New constructed pipe has been controlled on water - resistance, but there is problem with old pipes which are not being controlled systematically.

- Existing treatment plants need better maintenance and more educated persons for improving the results of operations.
- The control of quality and quantities of discharged wastewater has been difficult because of, in many cases, great number of discharging places, which are not arranged for taking the samples. Also the program for control of wastewater, indicators, frequency, sampling etc. calls for great improvements. Municipalities, which have the obligation for control of wastewater, not at all or not regularly deliver the wastewater control data to Croatian Waters. Result all of this is very bad information about real situation.
- Monitoring of surface waters has been established, but there is a great problem with defining the impact of wastewater discharging to surface water.
- Licensed laboratories, which control wastewater, are obliged to use Croatian Norm (ISO norm) but not all of them have all necessary and regular equipment.
- Lack of strategic legislation regulations about this area
- For future project there is great need to revise the existing designs because new after war changes connected with migration of population, changes in industrial production, different social and industrial situation.

There was no deleting the existing hot spots from the list. The municipality discharge of Bjelovar has been added to the list because of the big pollution load.

Vodno područje sliva	Parametri koji definiraju Hot Spot			
	KPK t/god (97)	BPK_5 t/god (97)	N t/god (97)	P t/god (97)
Sava				
Bjelovar	1 673	930	103	16
Karlovac	1 570	2 532	184	21
Sisak	1 225	875	158	18
Slavonski Brod	804	251	173	11
Zagreb	38 818	13 048	(95)a126	(95)o257
Drava				
Belišče	3 384	1 728	89	8
Belje	u 97. nisu vršena mjerenja			
Čakovec	434	537	17	1
Koprivnica	1 075	755	54	9
Osijek	3 562	1362	237	69
Varaždin	3 559	1 936	440	33
Dunav				
Vukovar	u 97. nisu vršena mjerenja			

Industrial and mining hot spots

SAP nominate hot spots are as follow: "Petrokemija" Kutina - Petrochemical and fertilizer plant, IPK Osijek - sugar factory, Željezara Sisak - steel industry, PIK VRBOVEC - meet industry.

In industrial activity in the whole country also in the Danube River Basin have been great changes because of war, and transition in last few years. The result of this is that many industrial plants work with reduced capacity or have even stopped production which finally result with a reduction of quantity of the discharging of wastewater and less pollution of the surface water.

Updated lists for industry show that SAP nominated industrial Hot Spots still exist. There has been only problem with hot spot Željezara Sisak - steel industry, which was a candidate for deletion from the list because of the lower pollution load than other hot spots. The reason for small pollution load is not improvement off treatment or producing process, but low production level. This is result of economic situation in the country. As there is no official plan to closing the capacity, in contrary, there is the attitude about revival of production, the hot spot can not be deleted from the list.

On the list has been added as follows:

PLIVA Savski Marof - pharmacy industry, Oil Refinery Sisak, Gavrilović Petrinja - meat industry, Sladorana Županja - sugar refinery, Belišće paper industry, Vegetable oil industry from Osijek. The reason for addition was high pollution load and impact on local receiving waters.

After analysis the list of Industries final conclusion is as follow:

- Most of industrial capacity produces with only part of the installed capacity. The reason for that is war situation, and economic transition quantity of discharged wastewater fell in last few years, and result of that is also the fall of pollution load.
- Pretreatment of industries is mostly not sufficient, badly maintained by not appropriately trained people.
- Monitoring of effluent has been carried out according Water Management Permits and it is more or less regular and successful. Main problem in monitoring industrial wastewater in measurement of quantity of wastewater.
- Monitoring of surface waters has been established, but there are great problems with defining the impact of wastewater discharging surface water.
- Licensed laboratories, which control wastewater, are obliged to use Croatian Norm (ISO norm) but all of them do not have all necessary and regulated equipment.
- Delivering of data about the wastewater control is regular in many cases and Croatian Waters calculates and Croatian Waters charges the water protection fee

Catchment area	**Parameters which define Hot Spot**			
	COD t/a (97)	**BOD_5 t/a (97)**	**N t/a (97)**	**P t/a (97)**
Sava				
GAVRILOVIĆ Petrinja	227	132	4	2
PETROKEMIJA Kutina	278	59	390	
PIK Vrbovec	210	106		
PLIVA Savski Marof	1 390	321		
RAFINERIJA Sisak	88	91		
SLADORANA Županja	1 240	560		
ŽELJEZARA Sisak	27	12	3	0,2
Drava				
BELIŠĆE Belišče	5 950	1 586		
BELJE Bilje	u 97. nisu vršena mjerenja			
IPK OSIJEK ŠEĆERANA	1 328	676		
IPK OSIJEK ULJARA	86	57		
Dunav				

Agricultural hot spots (point and diffuse sources)

In SAP there has not been nominated a hot spot.

The agricultural lists of parameters show which points can be nominated as hot spots.

After analyze the list of Farms final conclusion is as follow:

- The most of farms do not have appropriate pretreatment, or do not treat whole quantity of wastewater.
- The sludge from lagoons has been used in agriculture as fertilizers according to Regulations
- Monitoring of effluent has been carried out according to Water Management Permits and it is more or less regular and successful.
- Monitoring of surface waters has been established, but there are great problems with defining the impact of wastewater discharging surface water.
- Licensed laboratories, which control wastewater, are oblige to use Croatian Norm (ISO norm) but all of them do not have necessary and regulated equipment.
- Delivering data about wastewater control is regular in many cases and Croatian Waters calculates and Croatian Waters charges the water protection fee

Catchment area	Parameters which define Hot Spot			
	COD t/a (97)	BOD_5 t/a (97)	N t/a (97)	P t/a (97)
Sava				
DUBRAVICA Dubravica	589	212		
Farma LUŽANI	51	4		2
Drava				
FARMA SENKOVAC	4 193	1 675	10	4
Dunav				

Ranking criteria under consideration of transboundary effects

The criteria for ranking the hot spots is being addressed in the guidelines separately for municipal and agriculture hot spots and separately for industrial hot spots. However there is no detailed information about impacts on the receiving waters (size of affected area, intensity of affect, duration of affect); about impact we can only have a hypothesis, as with other relevant information; the main criteria for ranking hot spots which was used in this review was the size of pollution load, sensitivity of nearby downstream area used for the emission.

Now the national priority is reconstruction of the war affected areas and returning the people in these areas. So in these areas are now the great activity in reconstruction and building also the infrastructure (water supply systems and sewage systems). So in this context the ranking of hot spots will be rather different.

There is possible discussion about other ranking criteria in the future, but for any discussion there is great need for relevant information and today we don't have all of them. However the pollution reduction program has a main task of reduction of the pollution using the pollution load criteria. There does exist some information for these criteria. Also there is the information about sensitivity of the downstream river usage, and this one can be used as ranking criteria. Combination of these two criteria has been used in ranking.

We repeat that the development and application of the ranking criteria need better information and great discussion.

Municipal Hot Spots

High Priority: ZAGREB, OSIJEK, VARAŽDIN, KARLOVAC

Medium priority: SISAK, SLAVONSKI BROD, BJELOVAR, BELIŠĆE, KOPRIVNICA

Low priority: ČAKOVEC, BILJE, VUKOVAR

Industrial Hot Spots

High priority: BELIŠĆE, PLIVA, SUGAR REFINERY OSIJEK, SLADORANA ŽUPANJA

Medium Priority: PETROKEMIJA KUTINA; GAVRILOVIĆ PETRINJA, PIK VRBOVEC, OIL REFINERY SISAK

Low priority: ŽELJEZARA SISAK, VEGETABLE OIL FACTORY OSIJEK

Agricultural Hot Spots

High priority: FARM LUŽANI

Medium priority: FARM SENKOVAC

Low priority: FARM DUBRAVICA

6. Identification and Evaluation of Pollution Reduction Measures

6.1. National Targets and Instruments for Water Pollution Reduction

The water protection from pollution in Croatia is carried out in order to protect the environment, lives and health of people, and to provide the use of water for different purposes. The main statements about the water protection are given in Water Act (1995) which represents the main document of water management in Croatia. The water pollution control is conducted through monitoring of water quality and the sources of pollution. Furthermore, the actions such as prevention, restriction and even prohibition of activities which may have negative impact on water quality and the state of environment also play important roles to protect and improve the quality of water and environment itself.

The water protection in Croatia is conducted according to the State Plan for Water Protection from Pollution. The main aim of the State Plan for Water Protection from Pollution is to ensure the water management based on the principle of integrity of water system and on the principle of sustainable development. Other defined principles in this Plan are the principle of prevention, the principle of monitoring of pollution, the principle of use of the best suitable technologies, and the principle "polluters pay". Finally, the document emphasizes the need for constant exchange of information about the water quality with neighboring countries.

The State Plan describes the measures for water pollution control, the targets of the measures and schedule for implementation of these measures.

The targets of the measures are the following:

- Preservation of the water resources which are still clean, as in upstream parts of rivers and groundwater. These resources necessarily belong to the first category of water quality according to the existing categorization of water;
- Stopping the further degradation of water quality, which can be achieved through the implementation of the measures in medium and long-term periods;
- Restoration or removal of the sources of pollution are priorities as on existing or planned drinking water sources, as on other places where the water is used for different purposes (industry, agriculture, fishery, recreation, etc.). On these spots water is ranked to the second or third category according to the categorization standards.
- Strengthening of the monitoring over the sources of pollution and possible accidents is priority task in short-term period. By strengthening the monitoring it will be possible to make the database for water pollution control and accidental emergency warning system.

Measures for water protection from pollution can be divided into administrative measures, and measures for conservation of water quality.

The administrative measures are:

- making the water management plans for water basins and catchment areas which consist of estimation of critical amount of pollution together with solutions for reduction of pollution;
- changing and improving the existing water management licenses for discharge of wastewater in order to achieve the defined goals;
- permanent supervision of legislation for water pollution control and putting them into accordance with the defined measures for water pollution reduction

- making the technical documentation for conduction of the measures for water protection from pollution;
- Restoring the information system for the data about the state of environment.

The measures for conservation of water quality are:

- ban of building on the areas where direct threat to the quality of water exists, especially on significant places where surface water and groundwater is used for water supply;
- Restriction and prohibition of building on specially protected areas and valuable aquatic ecosystems (national parks, parks of nature, etc.)
- restriction on small watercourses and carst regions where wastewater discharges can have negative impacts on water quality even if the application of the measures for water pollution control take place;
- ban of discharge of hazardous substances which are defined in Ordinance on maximum allowed concentrations of hazardous substances in water
- increase of the capacities of recipients by building appropriate facilities

The measures for reduction and stopping of water pollution are:

- planning, reconstruction and building sewage systems;
- planning, reconstruction and building wastewater treatment plants;
- reduction of pollution from different technological processes and adaptation of systems in accordance to prescribed maximum allowed concentrations;
- replacement of technologies where hazardous substances exist with better and cleaner technologies;
- introduction of measures for water pollution reduction from agriculture together with acceptable use of fertilizers;
- arrangement of erosion areas and stopping erosion processes by building regulation facilities and by reforestation;
- building of appropriate dump sites;
- restoration of existing dump sites, specially on the places where the threat for valuable groundwater and surface water resources exist (potable water);
- Restoration of sources of pollution on seacoast that cause the limited use of sea for various purposes (fishery, recreation, and tourism).

National targets and instruments for reduction of water pollution are defined by Water Act (1995) and by numerous other technical regulations.

Several documents issued by authorities serve as an instrument for water pollution reduction. These documents are water management conditions, water management approvals, water management permits and permit ordinances.

They are issued either by the Water State Directorate or Croatian Waters (the firm responsible for carrying out water management activities) or county offices in accordance with Croatian Waters. The main aim of these water-related documents is to secure the uniform water regime and to establish water management in accordance with the Water Act. Therefore, these administrative arrangements must be realized when some facilities exist which can have an impact on water regime. More sophisticated cases require the environmental impact assessments.

The recently passed Ordinance about hazardous substances in waters may also be considered as an instrument for water pollution reduction. In this document the maximum concentration of hazardous substances that can be found in water are defined and these concentrations are in accordance with EU norms.

6.2. Measures for Reduction of Water Pollution

There are 64 projects recommended as measures for reduction of water pollution. Two of them are non-structural projects, whereas all others are structural projects. The total investment costs are estimated at cca. 664 millions US$. The summary of number of recommended projects taking into account the type of projects and main river basins in Croatia is given in table below:

River Basin	The number of recommended projects for							
	Municipal hot spots		Industrial hot spots		Agricultural hot spots		Dump sites	
	Ongoing	Planned	Ongoing	Planned	Ongoing	Planned	Ongoing	Planned
Sava	6	17	2	2	2	1	2	5
Drava	4	14	-	2	-	-	-	7
Total	10	31	2	4	2	1	2	12
	41		6		3		14	

6.3. Expected Regional and Transboundary Effects of Actual and Planned Measures

Due to the lack of data in project files it is impossible to quantify exactly the expected amount of reduction of nutrient emissions, hazardous substances, microbiological contamination and adverse environmental effects of recommended projects. Moreover, the difficulty in estimation of expected effects is also due to lack of such analysis in project documentation. Nevertheless, it is important to emphasize that all recommended projects in case of their realization will be of great importance for the improvement of water quality and environment itself.

7. Analysis of National Financial Mechanism

7.1. Policies of Funding of Water Sector Programs and Projects

With respect to the importance of water for life and national economy, the objectives of the society in the water sector are included in the fundamental document - the Constitution. The Constitution stresses in particular the protection of nature and the environment, conservation and use of natural and cultural resources. The Water Act (NN 107/95) and the Water Management Financing Act (NN 107/95) further elaborate the relation to water in more detail.

The Water Act defines the legal status of water and water-related estate, as well as the founding of "Hrvatske vode" - legal entity for water management.

Water management is a group of very complex activities aiming at rational use and protection from water (meeting of human demands), simultaneously with protection of natural and cultural heritage and other values.

In this context, particular importance is assigned to designing, construction, maintenance and utilization of multipurpose water management projects.

In planning of water management projects it is necessary to bear in mind the fact that this process is taking place in the context of existing institutions and planning procedures, through two-way dialogue with previously defined problems, tasks, and criteria. The team of professionals involved in the project must cooperate with the institutions which, in accordance with the Water Act, are entrusted with planning and control of water management facilities and systems. Timely incorporating of planning of water management facilities in regional and national plans is of particular importance.

For optimum technical and financial solutions of water management projects it is important to prepare beforehand the water master plans on river basin, regional and national levels. The water master plan is a long term planning document determining the base of water management, water balance and improvements of the water system, providing the uniform and harmonious water regime on the river basin and the national level. In its policy "Hrvatske vode" integrates relevant scientific institutions in the process of developing of scientific and research projects in search of optimum engineering, technological and financial solutions of water management projects, in particular multipurpose projects. "Hrvatske vode" finances scientific research projects jointly with the Ministry of Science and Technology, together with other beneficiaries including, in the first place, agriculture, municipal companies, transport, forestry and some industries. Depending on the kind of project, the research usually takes 5 years. As a rule, "Hrvatske vode" co-finances the projects up to 50 percent (14 projects in 1995, 19 in 1996, and 18 in 1997).

Water Supply

Planning of water supply is done at three different levels; the national, county, and town or municipal level. The Water Act of 1995 determines that water use must be regulated through multipurpose planning on the basis of water management permits and concessions. The most important objective of water supply development in Croatia is providing of water of adequate quantity and quality to meat the demands of population and industry. The general development plan of water supply for the period to 2000 is based on the objectives of social and economic development. The water requirements in Croatia for water supply are, as follows: the initial status in 1995 is 27.5 cu.m./sec, and the development program for 2000 is 48.4 cu.m./sec. The planned investment in water supply development amounts to approximately HRK 5,5 billion (USD 900 million), or about HRK 1.150 (USD 180) per capita. The development plan of water supply in Croatia within the National Water Master Plan is adjusted to the national environment planning and protection, and based on the concept of sustainable development.

Municipal wastewater treatment

Water pollution control is one of the essential components of water management. Sewerage is an unavoidable part of infrastructure of vital importance to human health and environment. Its maintenance and improvement is costly. Proper planning is essential for finding of optimum technical and financial solutions.

Water pollution control is regulated by the Water Act (NN 107/1995) and implemented by "Hrvatske vode" as well as by all water users.

Water pollution control regulations determine the limit values of concentration of hazardous and harmful substances in water, limit values to be met by industrial wastewater before discharging into municipal sewerage after pretreatment (effluent standard) and the obligatory treatment of wastewater likely to cause pollution or contamination. The regulation also includes water classification with regard to quality, and conditions of water use for various purposes. Water pollution control is carried out in accordance with the National Water Protection Plan and the county plans.

Those plans determine, in particular: the required research and monitoring of water quality, protection and emergency measures, plans of construction of wastewater disposal and treatment facilities. The National Plan includes wastewater treatment plants with the capacity over 50,000 P.E. A component of the Plan is also water categorization. The Government of the Republic of Croatia passes the National Water Protection Plan.

The respective county assemblies, upon proposal pass the county plans by "Hrvatske vode".

Industrial wastewater treatment

At first, discharging of various kinds of wastewater was based on dilution principle, with harmful substances being gradually diluted in water. In the next stage, some plants (filters, pretreatment, etc.) were used before the wastewater leaves the industrial compound. Afterwards, recycling was applied in order to re-use as much waste material as possible, and at present, clean technology is being applied.

Industrial processes produce large quantities of wastewater with varying degree of pollution. Wastewater may be divided into cooling, process, sanitary, rain and percolating water, or a mixture thereof.

In water management an important issue is establishing of monitoring of wastewater industrial plants and issuing of certificates, which is regulated by the Water Act (NN 107/1995) and the basic legal and technical document under the Water Act is the water-management permit.

Improvement of agricultural practice

One of the fundamental preconditions for harmonious development of the society is provision of adequate quantities of food and other agricultural products. As all available agricultural land is, more or less, already utilized, future requirements will be possible to cover only by increasing the yields, which depends on two key parameters: CRP varieties, and adequate agrotechnical measures, including water supply.

Increased, i.e. specialized agricultural production is characterized by high input of agrochemical (pesticides, fertilizers, etc.) and energy, simultaneously resulting in considerable environment pollution. Ecological management in agriculture requires:

- Improved organization and control of application of all agrotechnical and other measures in production,
- Improved soil utilization and reduction of adverse effects,

- More efficient use of fertilizers and protective chemicals, and reduction of their runoff outside the area of application,
- Research and development of non-chemical and non-poisonous methods of fertilization and protection,
- Enforcement of discipline and strict control over discharging of wastewater from processing industry and livestock farms, although the Water Act demands wastewater treatment before discharging into the receiving water.

7.2. Funding Mechanisms for Water Sector Programs and Projects

Central national institutions and banks

The funds for financing of water management activities are provided in accordance with the Water Management Financing Act.

The annual plans, which are the basis of water management, present separately the expenditures for regular activities, and separately the capital expenditures and transfers. These plans are made before the beginning of the fiscal year, e.e. simultaneously with passing of the Government budget in the Croatian Parliament. According to the Budget Act (NN 92/94) all non-budgetary funds, including "Hrvatske vode", must pass their planning documents at the same time as the Government Budget.

The water sector programs and projects are financed from the sources defined by the Water Management Financing Act. A part of the funds is provided from the Government Budget and the budgets of local administration units. The planned deficit is covered by loans from local and foreign banks and by concessions.

As the water sector is closely connected and interdependent with the other sectors of economy the Croatian National Bank (HNB) plays on important role. HNB extends loans to other banks, carries out monetary emission operations, controls the operations of other banks, takes care of the foreign change policy and international liquidity of the country, and of the international payment. In 1996, HNB controlled 56 local banks and savings banks, with the total capital of HRK 73.9 billion, or USD 11.55 billion.

The Croatian National Bank cooperates with international financial institutions (IMF, World Bank, European Bank for Reconstruction and Development).

The war in Croatia and the post-war years resulted in great damages to the national economy and for the purpose of reconstruction, the Government of the Republic of Croatia established the Croatian Bank for Reconstruction and Development (HBOR) based on the model of Kreditanstalt fur Wiederbau, Frankfurt/Main, Germany. HBOR has the capital of HRK 3.7 billion, or USD 500 million, and these funds were provided from the Government Budget for the period of 10 years.

HBOR also cooperates with the World Bank and the European Bank, as well as with the German bank for reconstruction - Kreditanstalt fur Wiederbau.

Out of local commercial banks, "Hrvatske vode" cooperates with Zagreba~ka banka Zagreb, which is the first Croatian bank established as a joint-stock company, and with Privredna banka Zagreb.

International cooperation with establishing development banks and funds for financing of water sector projects

For reconstruction and investment in water sector programs and projects, foreign funds are also used, in particular loans from the International Bank for Reconstruction and Development, Washington, and the European Bank for Reconstruction and Development, London, through the Ministry of Finance and the Croatian Bank for Reconstruction and Development. In addition, commercial loans from foreign banks are used through the credit line of Kreditanstalt fur Wiederbau and through the "Hermes" insurance.

International assistance from various international agencies, including the Japanese Grant Fund and GEF funds, is also used for financing of reconstruction of war damages, also through the World Bank - IBRD.

The beneficiaries of such fund may be only the governments, government institutions and private entrepreneurs with government guarantees.

7.3. Real Costs and Price Policy

Water levies and fees

Financing of the water sector is based on the principle that the collected funds are used strictly for specific programs and projects in the water sector (see table).

1. *Water use fee*

   Water use fee is paid for water intake and use, and for use of hydro power. In addition to the general water use, the funds of the water use fee are used for specific purposes, such a securing of water resources, research and construction of water use facilities.

   The water use fee is paid by legal entities and physical persons taking in or pumping water from watercourses, lakes, storage reservoirs, underground or other natural layers, and using it for drinking, industrial, technological, municipal or other purposes (irrigation and fish-farming). This fee is also paid by legal entities and persons using water for electric power generation or driving of industrial plants.

   The water use fee is paid per cubic meter of water taken and used, and for water delivered through water supply systems according to the quantity actually supplied.

   The fee for the use of water for generating of electric power is paid in proportion to power generated (kWh) and the use of hydro power for other plants is paid according to the plant power (kW). These funds belong to the local administration units and may be used only for development of local infrastructure (water supply, sewerage and local roads). The level of the water use fee is determined by the Government of the Republic of Croatia. The level may vary depending on water quality, specific conditions and investments required to provide adequate water quantities.

   The regulations for accounting and paying of the water use fee (NN/97) define the payers and the methods of accounting and payment. The following are the components of water price in 1996:

	HOUSEHOLDS	**INDUSTRY**
basic price	HRK 1.26	HRK 3.84
service tax 10%	0.12	-
specific purpose	2.00	2.50
water use fee	0.71	0.71
water protection fee	0.82	0.82
Total price:	HRK 4.91	HRK 7.87

2. *Water protection fee*

The fee for water protection from pollution is paid for polluting or contaminating water, and is used for preparing of water pollution control plans and organizing of their implementation, as well as for construction of treatment plants. The water protection fee is paid by legal entities and persons that discharge wastewater or other substances polluting water or affecting its quality and use.

The fee is paid in proportion to the quantity of discharged wastewater and to the degree of deterioration of water quality (quantity of hazardous substance, intensity of influence on water quality). The level of the fee is determined by the Government of the Republic of Croatia. The fee, except by that paid by users using their own treatment plants, cannot be lower than the costs of treatment.

Price of wastewater disposal (tax excluded)

	HOUSEHOLDS	**INDUSTRY**
	per cu.m.	per cu.m.
- basic price	HRK 0.68	HRK 1.28
- special purpose	0.35	0.35
- water protection fee	0.83	0.83
Total:	HRK 1.86	HRK 2.46

3. *Funds from municipal companies*

The Law on Municipal Services (NN 36/95) defined the principles and the methods of carrying out and financing of municipal services, and other issues related to municipal activities. Municipal services, among other things, include:

- disposal and treatment of wastewater,
- solid waste disposal.

The revenues of municipal companies are provided through:

a. price of municipal services
b. municipal levies
c. budgets of local administration units
d. other sources subject to special regulations

According to Article 18 of the Law on Municipal Services, the price and the method of payment is determined by provider of the services. The payers are owners or users of real estate.

4. *Funds from the Government Budget*

The Law on the Government Budget of the Republic of Croatia determines the structure of revenues and expenditures for the current year management of Government property and debts, use of revenues by the Budget users, sanctions, rights and duties of the Budget fund users. The Budget funds are provided to entities, which are in charge of implementation of specific purposes. The Budget funds may be used only for purposes specified by the Budget, to the level specified therein, and in accordance with the financial plan, quarterly and monthly plans.

5. *Concessions*

   The Law on Municipal Services includes a possibility of concession awarding for performing of municipal services. The concession is awarded on the basis of public competition or collecting of bids, and the decision is made by representative bodies of local administration units, taking into consideration in particular:

   - bidder's reputation,
   - bidder's capability to fulfill the conditions of concession,
   - bid conditions - technical and financial
   - bid conditions from environmental aspect

Social and private sector - costs of water protection and protection of environmental and aquatic ecosystems

Following the democratic developments in the political system of the Republic of Croatia and transition towards market-oriented economy, the differences between social and private sector have been greatly reduced, and the costs of protection of water, environment and aquatic ecosystems are regulated by the Regulations on accounting and payment of the water protection fee (NN 13/1991).

In assessment of the fee, the difference is not made between the private and the social sector, but between payers who pay the fee to legal entities carrying out water supply services, in proportion to the quantity of water supplied, and payers discharging technological wastewater, for which the degree of pollution is measured. The amount of the fee is determined by "Hrvatske vode".

Structure of costs of treatment plant construction and treatment plant operation (including revenues and expenditures)

Costs of construction of wastewater treatment for 40,000 P.E. with mechanical-biological treatment and temporary sludge treatment:

No.	Item	000 HRK	000 USD
1.	Connections	1,300	203
2.	Infrastructure	5,250	820
3.	Mechanical treatment	10,400	1,625
4.	Biological treatment	20,000	3,125
5.	Return sludge pumping	1,200	188
6.	Settling and disposal	2,900	453
7.	Sludge treatment	9,300	1,453
8.	Auxiliary facilities	2,700	422
	TOTAL:	53,050	8.289

1 USD = 6.4 HRK

Operating costs of wastewater treatment plant

No.	Item	000 HRK	000 USD
1.	Personnel	302	47
2.	Maintenance	630	98
3.	Power	845	132
4.	Raw material	1,195	186
5.	Transport	160	25
6.	Profit	820	128
	TOTAL:	3,952	616

Initial funds for investments and improving of water protection and protection of aquatic ecosystems

Construction of sewerage, treatment plants and discharges solves the problems of wastewater from settlements and a number of industries; however, as a rule, there is never enough money for their construction.

The annual schedule of construction and co-financing by "Hrvatske vode" is based on the management plans, in accordance with the following criteria:

- 25 percent in areas of particular national concern,
- 35 percent in towns and municipalities where the level of development of the sewerage system is below 30 percent,
- 50 percent in other towns and municipalities.

Capital expenditures and transfer are carried out in accordance with the Construction Act (NN 77/92, 26/93 and 33/95) and the Law on Procurement of Goods and Services and Contract Awarding (NN 192/97). The funds of water levy and fees are used on the principle of solidarity of all water users in Croatia, and if these are not sufficient, "Hrvatske vode" provides the funds through long-term loans from Croatian Bank for Reconstruction and Development, World Bank, and European Bank.

The loan conditions are, as follows:

- loan repayment period 5 - 15 years, including 2-year grace period,
- interest rate 5-8 percent per annum.

The funds for construction of new water protection facilities, which are not the property of the Republic of Croatia, are given as loans or as participation in investments resulting in property rights (shares, stocks).

7.4. Present and Future Social and Private Investments in Water Sector (Water Supply and Protection) Projects

With respect to large damages to water sector facilities during the war, so far the investments in major water sector projects have dealt with reconstruction of war damages, mainly through the loans by IBRD, Croatian Bank for Reconstruction and Development and loans from Kreditanstalt fur Wiederbau and through "Hermes" insurance.

8. Development of National Pollution Reduction Program and Investment Package

8.1. Identification, Description and Project Cost Estimate
(Existing maintained and newly proposed pollution reduction projects)

The funds for financing of treatment plants were never sufficient. Thus, on the territory of the Republic of Croatia about 17 percent of municipal wastewater is undergoing secondary treatment which, including industrial wastewater, comes to about 8 percent P.E.

Status of water treatment plants in the Danube basin:

River basin	Population, 000	P.E. 000	P.E.	
			Connected to plants 1%	
			II stage	primary stage
Save	2,573	5,509	4.5	1.2
Drave i Dunava	343	1,524	33.4	17.5

During the war, many industrial plants were destroyed and the industrial activity has been reduced; as a result, the actual P.E. is considerably lower.

8.2. Institutional Planning Capacities in Social and Private Sector

Water pollution reduction measures will be determined and implemented by the new National Water Protection Plan, which is in preparation, and by the County plans based on the National Plan. This plan will also define the financial requirements and sources and methods of financing. This plan will also determine the new water categorization based on the new Decree on Ecological Water Quality, in accordance with the Water Act.

Provision of best available technology

In the Republic of Croatia, one firm is registered with the Chamber of Commerce with available capacities for designing, construction, installation and start-up of waste water treatment plants - "Coning-Ekologija", Vara`din. Regarding the technology of water treatment the firm frequently cooperates with Professor Novak from Switzerland, as well as with institutions in Croatia (Faculties of Civil Engineering, Zagreb and Osijek, Institute of Civil Engineering in Croatia - IGH, etc.).

In competitive biddings under international loans, numerous foreign firms have taken part (e.g. Hans Huber, Germany), with their reference lists proving the high quality of construction of wastewater treatment plants.

Provision of best environmental practice

Working out the environmental impact study is a regular part of pre-investment procedure for projects likely to exert considerable influence on the environment. As an element of timely environmental concern, working out the study in Croatia is mandatory, subject to the Act on Physical Planning and Development.

Such studies are a contribution to environmental protection and a basis for:

- selection of optimum location or route of works,
- defining and proper managing of technological development,
- remedy measures at the location,
- establishing of data bank for providing information to other countries,
- establishing of based data for defining of environment development, protection and control strategy.

The requirements regarding the environmental impact study are defined by the Regulations on Environmental Impact Studies and the Environmental Protection Act (NN 82/94) as the fundamental law on environment protection, including water.

Annexes

Project List

PROJECT NUMBER	LOCATION (RIVER BASIN)	NAME & TYPE OF PROJECT	PROJECT STRATEGY & TARGETS	INVESTMENT COSTS	STATUS OF PROJECT
1	2	3	4	5	6
1	Sava	Sewerage system and wastewater treatment plant of Slavonski Brod	Upgrading of existing sewerage system and construction of wastewater treatment plant (80 000 p.e.) in order to improve the water quality of Glogovnica, Mrsunja and Sava river	50 000 000 US$	Planned project
2	Sava	Sewerage system and wastewater treatment plant of Županja	Upgrading of existing sewerage system and construction of wastewater treatment plant (60 000 p.e.); Improvement of water quality of Sava river	11 000 000 US$	Planned project
3	Sava	Sewerage system and wastewater treatment plant of Kutina	Upgrading of existing sewerage system and finishing of wastewater treatment plant with total capacity of p.e.30 000 (second and third phase of the project); Improvement of water quality of Kutinica river	12 500 000 US$	Planned project
4	Sava	Municipal wastewater treatment plant of Bjelovar	Upgrading of existing wastewater treatment plant in order to protect river Bjelovarska	6 660 000 US$	Ongoing project
5	Sava	Sewerage system and wastewater treatment plant of Vinkovci	Extension of sewerage system and construction of wastewater treatment plant (capacity of p.e. 70 000)	12 000 000 US$	Ongoing project
6	Sava	Municipal wastewater treatment plant of Velika	The building of wastewater treatment plant with capacity of 5 000 p.e. in order to reach prescribed category of Velièanka river	1 000 000 US$	Ongoing project

1	2	3	4	5	6
7	Sava	Sewerage system and wastewater treatment plant of towns Veliki Zdenci, Mali Zdenci and Grubišno Polje and industry “Zdenka”	Reconstruction of existing wastewater treatment plant of industry “Zdenka” after which the treatment of wastewater from Veliki Zdenci, Mali Zdenci and Grubišno Polje will be possible (capacity 14 000 p.e.)	6 213 000 US$	Planned project
8	Sava	Sewerage system and wastewater treatment plant of Daruvar	Reconstruction of sewerage system and wastewater treatment plant of Daruvar in order to finish the treatment the municipal wastewater of Daruvar and protect the Toplica river	938 000 US$	Planned project
9	Sava	Sewerage system and wastewater treatment plant of Garešnica	Finishing the building of sewerage system and reconstruction of wastewater treatment plant (12 000 p.e.) in order to protect Ilova river	2 350 000 US$	Ongoing project
10	Sava	Sewerage system and wastewater treatment plant of Pakrac and Lipik	Upgrading of existing wastewater treatment plant (biological treatment) with capacity of 10 000 p.e. in order to improve the water quality of Pakra river and to enable the use of water for local fish ponds	1 650 000 US$	Planned project
11	Sava	Sewerage system and wastewater treatment plant of Ogulin	Upgrading of existing sewerage system and construction of wastewater treatment plant in order to protect the potable groundwater reserves in sensitive carst region	3 350 000 US$	Planned project
12	Sava	Sewerage system and wastewater treatment plant of the National Park Plitvice Lakes	The building of wastewater treatment plant (capacity 20 000 p.e.) in order to protect water resources of the National Park Plitvice Lakes, groundwater in carst and river Korana (first category of quality)	16 000 000 US$	Planned project

1	2	3	4	5	6
13	Sava	Sewerage system and wastewater treatment plant of Sisak	Upgrading of sewerage system and construction of municipal wastewater treatment plant (capacity 90 000 p.e.) with aim to improve water quality of rivers Sava, Kupa and Odra	60 000 000 US$	Planned project
14	Sava	Sewerage system and wastewater treatment plant of towns Karlovac and Duga Resa	Extension of existing sewerage systems, connection of both systems of Karlovac and Duga Resa and building of wastewater treatment plant in order to stop further degradation of water quality of rivers Kupa and Mrežnica	50 000 000 US$	Ongoing project
15	Sava	Sewerage system and wastewater treatment plant of Petrinja	The construction of wastewater treatment plant (mechanical – biological treatment) with capacity of 50 000 ES in order to protect the rivers Kupa and Petrinjćica	31 000 000 US$	Planned project
16	Sava	The central wastewater treatment plant for region of towns Zabok-Orosavlje-Donja Stubica-Gornja Stubica	Construction of central wastewater treatment plant of capacity of 50 000 p.e. in order to reach the appropriate category of river Krapina (second category)	27 300 000 US$	Planned project
17	Sava	Wastewater treatment plant of Samobor	Reconstruction of existing wastewater treatment plant in order to decrease the pollution of river Sava	-	Planned project
18	Sava	Wastewater treatment plant of Sesvete – east	Mechanical – biological treatment (30 000 p.e.) of municipal and industrial wastewater for a part of Sesvete	-	Planned project
19	Sava	Wastewater treatment plant of Zagreb	Construction of central wastewater treatment plant in order to improve the quality of river Sava	256 000 000 US$	Planned project

1	2	3	4	5	6
20	Sava	Wastewater treatment plant of Sesvete – south-east	Mechanical – biological treatment (30 000 p.e.) of municipal and industrial wastewater for a part of Sesvete	-	Planned project
21	Sava	Wastewater treatment plant of Zaprešić	Construction of central wastewater treatment plant	-	Planned project
22	Sava	Wastewater treatment plant of Velika Gorica	Reconstruction of equipment for mechanical treatment with capacity of 12 000 p.e.	2 200 000 US$	Ongoing project
23	Sava	Wastewater treatment plant of Krašić	The construction of wastewater treatment plant (4150 p.e.) in order to protect the river Kupčina	552 000 US$	Planned project
24	Drava	Wastewater treatment plant of Našice	The construction of the mechanical part (I phase) of the municipal wastewater treatment plant in order to protect the river Našička rijeka	1 100 000 US$	Ongoing project
25	Drava	The general solution of the sewerage system of Osijek	The solution of sewerage system by constructing the south sewerage collector which will bring municipal and industrial wastewater to the location for future wastewater treatment plant of city of Osijek	5 630 000 US$	Ongoing project
26	Drava	The treatment of wastewater of Durdenovac	The construction of wastewater treatment plant	2 960 000 US$	Planned project
27	Drava	The sewerage system of Durdenovac	Upgrading of existing sewerage system by enlarging the sewerage system to 11 nearby towns and villages	4 861 000 US$	Planned project
28	Drava	Sewerage system and wastewater treatment plant of Belišće	Upgrading of existing sewerage system and reconstruction of wastewater treatment plant (war damages)	4 800 000 US$	Planned project

1	2	3	4	5	6
29	Drava	Wastewater treatment plant of Donji Miholjac	Finishing of mechanical part of municipal wastewater treatment plant and building of part for biological treatment and sludge	-	Planned project
30	Drava	Wastewater treatment plant of Orahovica	Construction of municipal wastewater treatment plant in order to protect pollution of river Vučica	1 100 000 US$	Planned project
31	Drava	Sewerage system of Bizovac	The drainage of wastewater of Bizovac by sewerage network to the location of future wastewater treatment plant in order to improve tourism (Bizovac spa)	1 230 000 US$	Planned project
32	Drava	Wastewater treatment plant of Bizovac	Construction of wastewater treatment plant in order to protect pollution of river Karašica and Drava (thermal and domestic wastewater)	4 125 000 US$	Planned project
33	Drava	Sewerage system of Čepin	Construction of sewerage system (10 000 meters of sewerage collector and 40 000 meters of secondary network)	11 732 000 US$	Planned project
34	Drava	Retention basin on wastewater treatment plant of Virovitica	Acceptance of highly polluted water during intensive storms and further treatment on existing wastewater treatment plant	1 770 000 US$	Ongoing project
35	Drava	The sewerage system and wastewater treatment plant of Ilok	Upgrading the existing sewerage system and construction of wastewater treatment plant	31 130 000 US$	Planned project
36	Drava	The sewerage system and wastewater treatment plant of Slatina	Construction of main collector and wastewater treatment plant in order to stop the spilling of wastewater in one part of town Slatina	3 675 000 US$	Planned project
37	Drava	Wastewater treatment plant of Čakovec and nearby towns and villages	The construction of wastewater treatment plant in order to stop pollution of river Trnava	7 316 000 US$	Ongoing project

1	2	3	4	5	6
38	Drava	Wastewater treatment plant of Novi Marof	The construction of wastewater treatment plant in order to stop pollution of river Bednja	2 335 000 US$	Planned project
39	Drava	Wastewater treatment plant of Ivanec	The construction of wastewater treatment plant in order to stop pollution of river Bednja	950 000 US$	Planned project
40	Drava	Wastewater treatment plant of Koprivnica	The construction of wastewater treatment plant (101 000 p.e.) in order to stop pollution of river Bistra and river Drava	10 840 000 US$	Planned project
41	Drava	The sewerage system and wastewater treatment plant of Prelog	Upgrading the existing sewerage system and construction of wastewater treatment plant	7 783 000 US$	Planned project
42	Sava	The sewerage system and wastewater treatment of the farm “Dubravice d.d.”	Reconstruction of sewerage system and stabilization of sludge	-	Planned project
43	Sava	Erosion and sustainable soil management for middle Croatia region (nonstructural project)	Definition of most appropriate manner for land use in agricultural production in order to define influence of different land uses on aquatic ecosystems and drinking water	72 000 US$	Ongoing project
44	Sava	The influence of increased quantity of mineralized nitrogen on its rinse and growth of plants (nonstructural project)	Definition of optimal use of nitrogen mineralized fertilizers in agricultural production in order to stop water pollution	32 000 US$	Ongoing project
45	Sava	Treatment of wastewater of meat factory PIK “Vrbovec”	Upgrading of local wastewater treatment plant in order to stop heavy organic pollution of river Luka	-	Planned project
46	Sava	Treatment of wastewater of meat factory “Gavrilović d.o.o.” Petrinja (I phase)	Reconstruction of factory sewerage system and existing wastewater treatment plant in order to reduce the pollution of river Kupa	343 000 US$	Ongoing project
47	Sava	Wastewater treatment plant of “Agroproteinka d.d.”	The characteristic treatment of wastewater by mechanical and biological treatment in order to improve the water quality of Sava river	-	Planned project

1	2	3	4	5	6
48	Sava	The building of the system for the collection and treatment of chemical industry “Petrokemija” d.d. Kutina	The reduction of wastewater quantity and the reduction of pollution	953 000 US$	Ongoing project
49	Drava	Treatment of wastewater of food factory “Kvasac-Podravka d.d.” Koprivnica	Reconstruction of existing wastewater treatment plant in order to meet water quality standards defined in water management permit	225 000 US$	Planned project
50	Drava	Treatment of wastewater of industrial area Danica of Koprivnica	The construction of wastewater treatment plant in order to reduce the load on municipal wastewater treatment plant of Koprivnica	4 000 000 US$	Planned project
51	Sava	Rehabilitation of municipal dump site of Sisak	Step by step approach up to 2002 to achieve final rehabilitation of dump site	6 154 000 US$	
52	Sava	Municipal dump site of Bjelovar	The building of appropriate municipal dump site to solve the problem of solid waste for longer period (I phase)	2 235 000 US$	
53	Sava	Municipal dump site “Grginac” of city of Bjelovar	The remedy of the dump site “Grginac”	935 000 US$	
54	Sava	Municipal dump site of Daruvar	Rehabilitation of existing dump site	1 200 000 US$	
55	Sava	Municipal dump site of Nova Gradiška	Solution of dump site for solid waste on organized and controlled manner	95 000 US$	
56	Sava	Municipal dump site of Oriovac	Construction of dump site with appropriated facilities	44 000 US$	
57	Sava	The dump site of Požeška kotlina region	Solution for deposition of solid waste for 2 towns and 6 municipalities	1 557 000 US$	
58	Drava	Municipal dump site “Pustošije” (Čakovec)	Construction of municipal dump site for whole Međimurska region	-	

1	2	3	4	5	6
59	Drava	Municipal dump site of Slatina	Rehabilitation of existing dump site and building of new site for municipal solid waste on other location	206 000 US$	
60	Drava	Municipal dump site of Orahovica	Rehabilitation of existing dump site	752 000 US$	
61	Drava	Regional landfill for Eastern Slavonia	Protection of water resources	27 000 000 US$	
62	Drava	Center for pre-processing and storage of dangerous waste for Osječko-baranjska County	Construction of facilities for pre-processing, storage and disposal of dangerous waste	1 770 000 US$	
63	Drava	Temporary landfill “Lončarica Velika”	Disposal of municipal waste of the city of Osijek	2 700 000 US$	
64	Drava	Municipal dump site of Osijek (locality Sarvaš)	Improvement of sanitary condition of landfill Sarvaš	-	