DANUBE POLLUTION REDUCTION PROGRAMME

NATIONAL REVIEWS 1998
UKRAINE

TECHNICAL REPORTS

Part C: Water Quality

Part D: Water Environmental Engineering

Ministry of Environmental Protection and Nuclear Safety

in cooperation with the

Programme Coordination Unit
UNDP/GEF Assistance

DANUBE POLLUTION REDUCTION PROGRAMME

NATIONAL REVIEWS 1998
UKRAINE

TECHNICAL REPORTS

Part C: Water Quality

Part D: Water Environmental Engineering

Ministry of Environmental Protection and Nuclear Safety

in cooperation with the

Programme Coordination Unit

UNDP/GEF Assistance

Preface

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

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

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

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

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

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

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

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

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

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

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

The **Ukrainian National Reviews** were prepared under the supervision of the Country Programme Coordinator, **Mr. Vasyl Vasylchenko**. The authors of the respective parts of the report are:

- Part A: Social and Economic Analysis: **Ms. N. Tomashes'ska**
- Part B: Financing Mechanisms: **Ms. I. Sherban**
- Part C: Water Quality: **Ms. O. Tarasova**
- Part D: Water Environmental Engineering: **Mr. A. Obodovsky**

The Ministry of Environmental Protection and Nuclear Safety

The UNDP/GEF Danube Pollution Reduction Programme,
Danube Programme Coordination Unit (DPCU)
P.O.Box 500, 1400 Vienna – Austria
Tel: +43 1 26060 5610
Fax: +43 1 26060 5837

Vienna – Austria, November 1998

Part C

Water Quality

Table of Contents

List of Tables

Annexes

List of Figures

List of Abbreviations on Water Quality

BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
m^3/s	cubic meters per second
m^3	cubic meters
m^2	square m
WWTP	Wastewater Treatment Plant
TPE	One thousand population equivalent
ppm	parts per million

Glossary
on Water Quality

Biological Oxygen Demand

Chemical Oxygen Demand

Hot Spots - areas where pollution from industrial, municipal, agricultural and other non-point or diffuse sources has already resulted or is expected to result in critical adverse impacts on water quality and by this on ecologically sensitive areas and human health which may affect national, regional and local economies or have transboundary impact on water quality.

Nutrient load

One thousand population equivalent - 1 population equivalent = 60 g per day BOD

Pollution load

Raw Water Load - load in TPE, which is entering the waste treatment plants

1. Summary

1.1. Updating, Evaluation and Ranking of Hot Spots

For many years the human pressure on water quality of the Danube River itself and rivers and streams of its basin exceeded the limits, within which the sustainable functioning of ecosystems of the Danube River basin occurred. Deteriorated water quality affected many water uses, especially human health and recreation.

The Danube Environmental Programme launched in 1991 consolidated efforts of riparian countries directed toward improvement of the Danube water quality, harmonization of approaches to water management and water quality assessments. Strategic Action Plan was an important step to implementation of the common strategy from country to country.

Economic crisis in most of post-Soviet countries mitigated the impact of human activities on the environment of the Danube River Basin resulting in large-scale experiments on ecosystems of the region.

Rather realistic expectations of pollution reduction became partly true but not to the extent proportional to decrease of industrial and agricultural activities in Ukraine. For example pesticide load per ha in Ivano-Frankivsk region decreased almost by 10 times. By twenty percents decreased the areas of cultivated lands. Transition to market economy and slow transition from state to private land ownership imposed political problems.

Existing municipal sewer systems and wastewater treatment plants as a rule are overloaded and have outdated technological equipment. Poor maintenance of technological equipment results in frequent accidents with significant discharge untreated wastewater directly in the river of the basin.

The Danube riverbed is enriched by plants and animals that live and develop in the river, first of all in pelagic zone. The total volume of the plankton flow, besides nutrients, determines the efficiency of the mouth of the delta, the scale of influence on the Black Sea. The average annual volume of this flow at the top of the delta is about 1.340.000 tons, of which bacteria make up 80,8 %, phytoplankton – 11,1 % and zooplankton – 8,1%.

The zone of direct influence of Danube waters on the Black Sea is selected on the boundary of detection of freshwater algae, which continues to grow in marine water. Depending on the estimate of the river runoff, the area of the zone varies and the maximum size of the surface of the pelagic zone reaches 100.000 km^2.

The increasing of diversity, density and biomass of hydrobionts in the zone of transformation in comparison with adjacent areas can be considered as a manifestation of “edge effect” on the boundary of coexistence of brackish water and marine fauna. Usually in this zone total biomass and production of hydrobionts are higher by 2-5 times.

Regular blooming of the sea in a surface layer up to a depth of 10 m has been noted. The total phytoplankton biomass is more than 400.000 tons on an area about 40.000 km^2 in the summer time.

Among the animal population of the ecoton “river-sea” - there is an absolute prevalence of noctiluca, Noctiluca scintillans, making up to 90 % of the density and biomass of pelagic organisms. In 1988 to the south from Sfintu Gheorghe branch on an area about 3.400 km^2 super high biomass of this organism (125-560 $kg.m^3$) was registered.

The comparison of quantitative measurements of distribution of hydrobionts from the Danube riverbed up to the sea allows to state the following conformity to natural laws: on the average, the biomass of hydrobionts is 5-10 times higher in the sea than in the river (phytoplankton - 4,8 times, mesozooplankton - 4,3 times, macrozoobenthos - 8,1 times); in delta water bodies lower numbers and biomass of hydrobionts have been observed in comparison with adjacent zones - river branches and sea-coast.

The intensive sedimentation (or silting) and reduction of current in the river delta are the main reasons for this type of distribution of aquatic organisms.

The existence of many species of fish in a coastal complex, and also migrations, for example, of herring and sturgeon from the sea into the river, is illustrated by the existence of a high productive "river-sea" ecoton in the zone of the river mouth of the delta.

The fish fauna of the delta is remarkably rich, with 91 species belonging to 30 families. The majority of these (44) are freshwater species, the other being migratory species that occur in the Black Sea and mainly come to the delta during the breeding season.

After the construction of the Kakhovka dam on the Dnipro River (1955-58), the Danube became one of the last rivers where the sturgeons (starred sturgeon, Acipenser stellatus and great sturgeon, Huso huso) continued to spawn.

The most important problems resulting from the environmental degradation in the Danube River basin are as follow:

- impact on human health
- impaired functioning of aquatic and terrestrial ecosystems
- economic and social losses due to environmental pollution
- transboundary impact

The criteria for selection of "hot spots" were chosen and prioritized in following order:

1. impact of pollution on human health
2. transboundary impact
3. economic and ecological losses due to declining bio-productivity and biodiversity of aquatic and terrestrial ecosystems caused by environmental pollution
4. threats of irreversible damage to the natural environment
5. possibilities of low cost measures and win-win investments
6. ecological benefits/cost ratio or net social benefits maximization

Based on these criteria the following "hot spots" were selected within the Ukrainian section of the Danube River basin:

- *Municipal "hot spots"* include Chernivtsy WWTP, Uzhgorod WWTP, Kolomyia WWTP, Mukachevo WWTP, Izmail WWTP, small settlements of resort areas; small settlements of the Odessa Regions
- *Agricultural " hot spots"* include v. Lisky, social farm "Pogranychnyk", collective farm "Put Lenina", Kylia.
- *Industrial "hot spots*" include Rakhiv Cardboard Factory, Velyky Bychkiv Timber processing plant
- *Special "hot spots"* include crude oil transit pipeline "Druzba", car traffic of transboundary highways of Zakarpattia Region; abandoned ships in the Ukrainian Danube Delta.

Elimination of these hot spots will remove the most immediate threats to human health and will create the better conditions for recreation, drinking water supply and fisheries and ecological functioning of river ecosystems.

1.2. Updating, Analysis and Validation of Water Quality Data

Evident improvement of water quality in the Ukrainian section of the river Danube and its tributaries comparing to 80s reflects the economic difficulties in most of the countries of Central Europe as well as successes in introduction of harmonized environmental policies in all riparian countries of the Danube River basin.

In the Ukrainian section of the Danube River Basin the water quality was monitored by following variables.

Maximal content of suspended solids is observed during the summer seasons, and because the rivers are not covered with ice during winter periods. Small peaks in springtime are related to the spring flood events.

Monitoring data are presented only for mineral species of nitrogen meanwhile the total nitrogen content including mineral and organic species have not been analyzed.

Average annual concentration of the mineral species of nitrogen (sum of mineral species) in the Danube water varied between 1,39 and 0,51 mg/L with maximal concentrations 2,8 mg/L (Vylkovo and Izmail, 1996). By the monitoring data of the State Ecological Inspection the annual average nitrogen content was 9 mg/L. mostly as nitrates.

It is evident that the portion of ammonia and nitrites decreased significantly during a last three years. The highest concentrations of nitrates were recorded in 1994 and 1995 reaching 13 - 14mg/L. Usually the highest nitrogen content is accompanied by high water discharges.

The content of mineral nitrogen species in the major Danube tributaries range between 0,10 and 6,0 mg/L for Tisza River, 0,92 - 4,2 mg/L for Uzh River and 0,37 - 5,9 mg/L for Prut River. Long term trend of mineral nitrogen is reversibly related with water level. The prevailing concentrations are between 2,5 and 4,3mg/L with domination of nitrates and ammonium. The less abundant are nitrites.

The monitoring data are presented only for total phosphorus (data of the hydrometeorological station) for a period 1994 -1996.

Average concentration of total phosphorus in the Danube water varies between 0,14 - 0,47mg/L, with a range 0,06 - 1 mg/L. While in 1994 the changes of total phosphorus follow the changes of river discharges, later on its level became more stable. The phosphorus content in the major Danube tributaries is evidently lower than in Danube.

The most comprehensive monitoring data exist for BOD5 that creates a good base for long-term trends assessment of organic pollution.

Long term trend of BOD5 changes reveals the evident decrease of this variable. It can be explained by reduction of discharges of easily oxidized organic matter with industrial discharges due to decline of industrial output. Seasonal BOD5 variations in 1997 showed increase of readily available organic matter during high water periods.

BOD5 is rather stable in the Danube tributaries: 2 - 5,3 mg/L for Tisza River (primarily 4 mg/L), 2 - 5,7 mg/L with average 2,64 mg/L for Uzh, and 2 - 5,3 mg/L (average 2,65 - 3,75mg/L) for Prut.

Hydrometeorological monitoring network in Ukraine has rather complete and long-term observations only for copper, chromium, and zinc. At the same time ecological inspections monitor copper, zinc, manganese, lead, nickel, chromium and iron. Long term trends in heavy metals contents are relatively stable for copper and chromium and slightly less stable for manganese and zinc. During the last two years the contents of zinc and manganese have increased significantly.

Seasonal variations of the heavy metals contents are very typical with elevated concentrations during spring-summer that might be explained by corresponding variations of suspended solids content and other natural processes in water bodies. According to the water quality criteria maximum allowable concentrations of copper and chromium are 1 □ per L, and 10 □ per L for zinc, lead, and manganese.

Table 1.1. Annual average concentrations of heavy metals in the water of the river Danube, ppm

Year	Fe	Cu	Zn	Mn	Pb	Ni	Cr
1994	0,2442	14,417	26,653	14	10,236	1,4958	6,4347
1995	0,2493	14,292	24,139	14,611	10,722	1,4806	6,2472
1996	0,2255	12,879	24,864	13,212	11,227	1,5	6,7758
1997	0,23889	10,4306	30,0556	22,5556	10,5	1,575	6,29444

Variations of the heavy metals content in the major tributaries of the river Danube are much more significant, especially for zinc (65 - 132 μ/L in Tisza, 0 - 92 μ/L in Prut) and chromium (2,1 - 39 μ/L for Tisza, 1,6 - 75,8 μ/L for Uzh, 0 - 48 μ/L for Prut). While there are not available data on copper concentrations in Tisza and Uzh, the data on copper content varies significantly in water of the river Prut nearby the city of Chernivtsi. These elevated levels of the heavy metals (comparing to the existing standards) affect the water quality for recreation and fisheries uses.

Oil pollution has been monitored by ecological inspections as well as by hydrometeorogical stations. Elevated level of oil pollution in Kiliya Branch of the river Danube has in the most of cases the transboundary origin, including the impact from the river Prut. Concentrations of oil products in the Danube water varies were between 0 and 0,30 mg/L with average concentrations 0,08 - 0,11mg/L. (data of the State Committee on Hydrometeorology). According to existing assessment criteria the oil-polluted water (more than 0,05 mg/L) is not acceptable for fish reproduction when pollution events occur regularly.

Phenol pollution is much more serious because the minimal concentrations of these compounds are equal or higher than maximum allowable concentrations for fisheries and sanitary-hygienic uses. Seasonal variations of phenol contents are not significant with small peaks during spring and summer flood events. Big share of phenol pollution is released from the territory of Ukraine at the section between Reni and Vylkove.

There is not available data on content of phenol compounds in the major tributaries of the Danube.

In Ukraine the latest developments in environmental legislation and steps towards approaching the European environmental legislation contributed to the improvement of water quality. At the same time lack of sufficient financial resources does not allow Ukraine to maintain the municipal wastewater treatment facilities at the proper level, to improve water treatment in rural areas and small towns, to mitigate bacteriological pollution of surface and ground waters within the Ukrainian Section of the river Danube. Considering future industrial and socio-economic development in the region the necessary measures should be undertaken to prevent further pollution and environmental degradation of the Ukrainian section of the Danube River basin.

2. Updating of Hot Spots

Major municipal pollution sources are cities with the population over 100.000: Chernivtsy, Izmail, Mukachevo, Izmail; capacity of municipal wastewater treatment facilities is less than required by 1,5 - 2 times. Kolomyia with population about 70.000 may be included in the list of priority hot spots because its wastewater treatment facilities are overloaded by more 1,5.

The small towns with population more than 10.000 such as Kylia, Reni, Khust, Svaliava, Berehove, Vynogradiv, Rakhiv require the improvement of wastewater treatment facilities including reconstruction, renovation of facilities and construction anew. At the Ukrainian territory of the river Danube basin there are over 20 such small towns. Considering the future socio-economic development this problem has to be taken into account very seriously.

For small towns and villages with population less than 10.000 (Solotvino, Zastavne, Chop), all together 40, the wastewater treatment facilities should be constructed/reconstructed as well.

There are three directions for reduction of pollutant discharges from industrial sources.

The first one is the improvement and modernization of technological processes at the wood processing, timber processing and paper plants, especially for chemical plant at Teresva, and Izmail paper mill carton plant.

The second direction in pollution reduction from industrial sources is upgrading of existing wastewater treatment facilities at the wood processing plants: cardboard factory at Rakhiv, papermill at Kolomya, and timber processing plant at Svaliava, Perechyn, Kuty, Verkhovyna, Vorokhta and Diliatyn. These enterprises discharge wastewater directly into watercourses.

The third direction is the upgrading and construction wastewater treatment facilities at those enterprises that discharge wastewater to municipal sewage network: improvement of the existing and construction of new industrial local wastewater treatment plants before discharging to the sewer system.

The high level of land erosion of Ukrainian territory of the Danube basin determines the first priorities for actions in the nutrient load reduction through the creation of water protection zones and rehabilitation of eroded lands.

On a whole the level of water supply and sewer system is nor sufficient for the population of Danube river basin. In Zakarpattia Region only 14 small towns (or 50%) have centralized drinking water supply and 13 of them (or 46%) have sewer systems. Water treatment facilities operate reliably only in 5 small towns. Only 5 villages of 561 (3%) and 3 villages of 561 (1%) have centralized drinking water supply and sewer system respectively. 30% of existing sewer systems are in very bad condition. As a result, those hot spots that have not been included in Hot Spot list may be considered as hot spot. For example, Svaliava might be included in Hot Spot list because bacteriological pollution of water during a few past years. For these reasons as a top priority can be considered the improvement of wastewater treatment facilities of Mukachevo, Khust, Vynogradiv, Rakhiv, Tiachiv, Chop, Mezhugirria, Dubove, Yaseni, Bohdan, Zhdenievo.

The discharge of untreated sewer waters from animal farms is also very important for Ukraine. It is even more complicated because Ukraine relevant legislation and regulatory norms concerning agricultural enterprises have not been adopted yet. The most important for Ukrainian part of the Danube are animal farms of Kylia and Reni districts.

In Ivano-Frankivsk Region the discharges of polluted waters are 68 thousand m^3 per day (181,3 m^3 per day). The major sources of this pollution are health resorts that are situated in Vorokhta district. The major concern of this pollution is bacteriological pollution. For example, the sport camp “Zarosliak” discharges 14,0 thous. m^3 per year of polluted water. Since 1993 construction of wastewater facilities for Yaremche (capacity - 8,0 m^3 per day) has been started out but stopped because of lack of money. The same situation is similar in all other places of oblast.

2.1. General Approach and Methodology

The general approach and methodology developed by EMIS group was applied to update, evaluate and rank hot spots. Statements of this methodology were debated and mostly accepted by the water quality-working group during the January 1998 national reviews workshop, except for some minor modifications, under the following subsections.

The most important problems resulting from the environmental degradation in the Danube river basin are as follow:

- impact on human health
- impaired functioning of aquatic and terrestrial ecosystems
- economic and social losses due to environmental pollution
- transboundary impact

The criteria for selection of “hot spots” were chosen and prioritized in following order:

1. impact of pollution on human health
2. transboundary impact
3. economic and ecological losses due to declining bio-productivity and biodiversity of aquatic and terrestrial ecosystems caused by environmental pollution
4. threats of irreversible damage to the natural environment
5. possibilities of low cost measures and win-win investments
6. ecological benefits/cost ratio or net social benefits maximization

2.1.1 Evaluation of Existing Hot Spots

Municipal hot spots (including food industries, which produce wastewater dominated by BOD)

In Ukraine most of food processing industries with more or less high output is connected to municipal sewers therefore there is no reason to review them separately.

At existing municipal wastewater treatment facilities and plants mechanical and biological treatment technologies are very common. None of existing wastewater treatment facilities eliminates nitrogen or phosphorus.

Municipal hot spots listed below evidently show decline in wastewater discharges comparing to the year 1996, some times almost twice. If consider existing economic decline in Ukraine and potential economic growth in future all existing hotspots will remain at the list because the capacity will be overloaded. Poor maintenance, outdate equipment and technology will impose immediate threat to public health and environment of the Danube Basin.

The seasonal variations of river discharges show that a share of municipal discharges in total river discharge at the “hot spot” cross section can vary significantly, exceeding more than 5% of total river discharge, and evidently affecting water quality for downstream users and ecosystems (See Annexes).

This is true in case of Uzhgorod WWTP, Chernivtsi WWTP (Prut), and Kolomya WWTP (Prut). In case of Mukachiv and Izmail the influence of WWTPs are not very important from the point of nutrients loads due to sufficient dilution factor but may be important due to specific pollutants including phenol compounds, detergents and oil products. Serious problems are imposed by municipal sewer systems that collect wastewater from industrial enterprises, e.g. Izmail cardboard factory, and can be serious source of phenol pollution.

Other important issue is sanitary-hygienic state of streams of resort areas of Carpaty region and insufficiently treated municipal discharges imposing direct threat to the public health through pathogenic microflora. By existing classification system of the Ministry of Health of Ukraine (three category by coliforms bacteria pollution), in streams and rivers of first category percentage of deviation from the norm varies between 3,4 and 24,5 %, and for rivers and streams of second category - between 8,2 - 35,9. The most polluted with pathogenic microflora streams and rivers are those of Odessa and Chernistsi Regions. For example, in Kolomya district only 15% of wells have water quality in compliance with allowable norms. As a rule public wells are the most polluted (Table 2-2).

Table 2.1. Municipal hot spots and their major parameters of the Ukrainian part of the Danube River basin

No	Discharger/ Location	River/main catchment area	Raw water load (TPE)	Current capacity of WWTP (TPE)	Wastewater discharge 1997*	Wastewater discharge 1996*	Wastewater discharge 1991**	Ratio of wastewater discharge	Ratio of wastewater discharge	Raw water load/Current capacity	River discharge at hot spot, minimal during 1994-1996 period
		km^2			$Th.m^3/year$	$Th.m^3/year$	$Th.m^3/year$	1991/1997	1996/1997		$th.m^3/year$
1	Kolomyia WWTP	Prut	71,25	56,25	6.935,00	13.645,3	22.700	3,27	1,9	1,27	110.376
2	Mukachevo WWPT	Latorytsia	86,50	122,00	8.424,00	13.996,2	35.500	4,21	1,6	0,71	274.363
3	Izmail WWTP	Danube	69,90	157,50	6.800,00	10.197,0	46.300	6,80	1,5	0,44	131.000.000
4	Uzhgorod WWTP	Uzh	297,00	187,50	28.908,00	23.150,0	56.900	1,96	0,8	1,58	149.570
5	Chernivtsi WWTP	Prut	343,00	285,00	33.397,90	48.968,0	100.300	2,05	1,5	1,20	526.000

* *Draft National Strategic Action Plan , 1996*

** *National Report on the State of the Environment of the River Danube Basin*

Table 2.2. The indices of bacteriological pollution of surface waters (% of deviation from norms) at the Ukrainian section of the Danube River basin (1997)*

Regions	Waterbodies of the 1st category		Waterbodies of 2nd category	
	Indices of Lactozo- positive microorganisms	Pathogenic microorganisms	Indices of Lactozo- positive microorganisms	Pathogenic microorganisms
Zakarpattia region	4,7	0,0	8,2	0,0
Ivano-Frankivsk region	24,1	0,0	13,8	0,0
Odessa region	24,5	4,3	34,1	4,0
Chernivtsi region	3,4	0,0	35,9	5,1

** Statistics of the Ministry of Health*

The existing monitoring data indicate that pressure of bacteriological pollution on surface waters of Ukrainian part of the Danube River basin and risk of contagious diseases for population, except of Zakarpattia region, is rather high including pathogenic microflora. Additionally there are cases of bacteriological pollution of ground water including mineral springs of Svaliava.

Table 2.3. Discharge of nutrients and related variables at municipal hot spots

No	Discharger/Location	River Stretch	BOD	COD	N	P
			t/year	t/year	t/year	t/year
1	Izmail WWTP	Danube	41,20	109,7	213,40	37,50
2	Kolomyia WWTP	Prut	149,20	223,00	106,00	34,50
3	Mukachevo WWTP	Latorytsya	165,11	206,38	95,10	48,85
4	Chernivtsi WWTP	Prut	467,20	966,00	145,10	18,30
5	Uzhgorod WWTP	Uzh	646,00	807,50	326,70	130,10

Kolomyia Municipal Wastewater Treatment facilities are overloaded almost by two times. Part of sewer wastewater is discharged directly into the river Prut without any treatment (about 7 thousands m^3 per day or 2.555 Th. m^3 a year). Needs in increased capacity of sewer wastewater treatment facilities for the Kolomyia are 30 Th. m^3 per day or 10.950 Th. m^3 per year. For Kolomyia WWTP it is necessary to construct additional facilities for tertiary treatment.

Chernivtsi municipal wastewater treatment facilities are also overloaded. In 1988 - 1997 it was planned to complete the construction and introduce additional facilities with capacity 30 Th. m^3 a day or 10.950 Th. m^3 a year. Emergency discharge from pumping station at Vilde St., is very serious source of pollution. But lack of sufficient funding from state and local budget prevents the solution of this problem.

The Izmail wastewater treatment facilities belong to the cardboard factory and receive the municipal sewer water of Izmail by ratio 1:1. They were also overloaded but during economic decline when production of Izmail cardboard factory dramatically dropped down, these facilities can cover existing municipal need for Izmail City. As soon as production increases, the hot spot will inevitably spread out again with a lot of complications, because of outdated and poorly maintained technological equipment.

The Uzhgorod and Mukachiv wastewater treatment facilities of Zakarpattia Region are overloaded as well and discharge over 117.000 Th. m^3 a year of untreated sewage waters into Tisza, Latorytsia, Uzh.

Additionally to the “hot spot” listed in EMIS assessment for Ukraine the urgent problem is upgrading or construction of wastewater treatment facilities for the towns and villages, lack of which there may causes a decline of sanitary-hygienic conditions of rivers, streams, and ground waters of resort areas and results in threats to human health and economic losses from the deterioration of recreational resources.

Industrial hot spots (including abandoned sites and sites of frequent or serious accidents not covered by the Danube Basin Alarm Model).

List of major industrial enterprises of the Ukrainian part of the Danube River basin shows domination of papermills and timber processing industries in the region. Many of existing early industrial enterprises currently work at very low capacity or do not operate at all. Fish processing factory in Vylkovo (Odessa Region) hardly works at one tenth of its full capacity. The enterprises of all-union importance, e.g. machine building enterprise of Kylia ceased its operation. The river port of Izmail and Sea port of Ust-Dunaisk do not operate at their full capacities as well because of problems that have arisen during the conflicts in former Yugoslavia.

As clearly seen from Table 2.4. volume of industrial wastewater discharges decreased dramatically even in comparison with 1996. The restructuring of industrial sector and overall economic crisis of industries resulted in sharp decline of industrial production, sometimes up to complete closure of enterprises.

Table 2.4. List of major industrial enterprises of the Ukrainian part of the Danube River basin.

No	Discharger/Location	River/main catchment area	Wastewater discharge, 1996	Wastewater discharge, 1997	BOD, 1996	BOD, 1997
		Th.km^2	Th. m^3/year	Th. m^3/year	kg/m^3	
1	Cardboard plant, Rakhiv	Tizsa	3127,50	792,0	66,0	
2	Paper factory, Izmail	Danube	6168,6	4.293,0	19,2	
3	Paper mill, Kolomyia	Prut	412,45		53,10	
4	Pilot enterprise, Lusa	Prut	462,98		34,5	
5	Timber processing factory, Berehomet	Prut	146,0	78,0	26,8	
6	Timber processing factory, Cheremosh	Cheremosh	51,40		20,7	
7	Timber processing factory, Deliatyna	Prut	315,6		28,1	
8	Timber processing factory, Perchyna	Uzh	91,25	1,0	41,7	
9	Timber processing factory, Teresva	Tizsa	441,00		30,0	
10	Timber processing factory, Verkhovyna	Cheremosh	52,30	1,0	37,5	
11	Timber processing factory, Vorokhta	Prut	325,10		33,8	
12	Timber processing plant, Svaliava	Latorytsia	29,93	1,0	23,0	
13	Timber processing plant, V.Bychkov	Tizsa	839,86		27,0	
14	Crude oil pipelines “Druzhba”	Tizsa				

Table 2.5. Discharge of nutrients from the industrial source of the Ukrainian part of the Danube River basin

No	Discharger/Location	BOD	COD	N	P
1	Cardboard plant, Rakhiv	66,0	*	34,6	20,6
2	Paper factory, Izmail	19,2	*	16,6	4,1
3	Paper mill, Kolomyia	53,10	*	13,1	6,5
4	Pilot enterprise, Lusa	34,5	*	19,2	1,4
5	Timber processing factory, Berehomet	26,8	*	22	6,7
6	Timber processing factory, Cheremosh	20,7	*	21,5	5,5
7	Timber processing factory, Deliatyna	28,1	*	22,4	3,9
8	Timber processing factory, Perchyna	41,7	*	40	0,96
9	Timber processing factory, Teresva	30,0	*	40,0	4,0
10	Timber processing factory, Verkhovyna	37,5	*	26,1	3,4
11	Timber processing factory, Vorokhta	33,8	*	18,5	2,1
12	Timber processing plant, V.Bychkov	23,0	*	7,5	1,6
13	Timber processing plant, Svaliava	27,0	*	8,7	2,6

Table 2.6. Discharges of major pollutants from the industrial sources of the Ukrainian part of the Danube River basin

No	Discharger/ Location	BOD	COD	Oil pro-ducts	Sus-pended Solids	NH4	NO2	NO3	Cl	SO4	Phenol
1	Timber processing factory, Perchyna										
2	Pilot enterprise, Lusa										
3	*Timber processing plant, V.Bychkov	1	*	1	*	*	*	*	*	*	0,002
4	Timber processing factory, Vorokhta										
5	Timber processing plant, Svaliava										
6	Timber processing factory, Verkhovyna										
7	Timber processing factory, Deliatyna										
8	*Timber processing factory, Teresva	1	*	*	2	*	1	1	3	4	*0,002
9	* Paper factory, Izmail	25,8	*	0,37	11,6	12,8	*	*	613,9	*	
10	Timber processing factory, Cheremosh										
11	Paper mill, Kolomyia										
12	Timber processing factory, Berehomet										
13	*Cardboard plant, Rakhiv	39	*	*	82	10	1	12	31	36	*
14	Crude oil pipelines: ”Druzhba”			15,9							

By EMIS expert group assessment only 4 enterprises are included in the list of “hot spots: in Ukraine - Rakhiv Cardboard Plant, Izmail Cardboard Plant, Velyky Bychkiv Timber Processing Plant, and Teresva Timber Processing Plant.

At the moment it is difficult to predict the future pollution loads from listed in the Table enterprises because of transition to private ownership in Ukraine’s economy.

Special attention should be paid to transit crude oil pipelines “Druzhba”. Only in Zakarpattia region two accidents intentionally caused by local individuals resulted in oil spill of 15,9 ton/year. The pipes are old and heavily corroded that results in frequent oil spills and pollution of surface and ground waters. For four months of 1994 it was reported on 11 accidents and more than 300 t oil spills.

The existing methods of pollution clean up are not efficient for mountainous rivers and streams because of strong currents. This pollution may also have serious transboundary implications for water users of the Slovak Republic and Hungary because the water quality of Latorytsya, Tisza and other tributaries of the Danube River may seriously deteriorate.

Agricultural hot spots

By the data of State Ecological Inspection in 1997 almost 74 thousand m^3 have been discharged from agricultural enterprises only in the very vicinity/or directly into the Danube (Table 2.7.). 73,4 thousand m^3 have been discharged untreated. From this point of view at least two major polluters in the region can be considered as agricultural hot spots (v. Lisky, social farm “Pogranychnyk”, collective farm “Put Lenina”, Kylia).

Existing statistical data are very unreliable and can be used only for very rough assessment. Transition from centralized to market economy in agricultural sector is facing the major changes in the form of ownership - state or private. Most of listed below agricultural enterprises are facing difficulties in this transition. Additional studies and measurement are needed for assessment whether impact of the Danube water quality is significant.

Table 2.7. Sewage water discharges from agricultural enterprises

No	Discharger/Location	River/main catchment area	Wastewater discharge Th. m^3/year	Untreated
1	Collective an state farm “Berehivsky”		0,01	
2	v.Korolevo, Shevchenko Collective farm		0,027	
3	Reni cattle feeding center	Danube	0,112	0,108
4	Kiliya, Sverdlov State Farm	Danube	0,126	0,114
5	v.Kotlovina, Reni region Pobeda State Farm	Danube	0,218	0,178
6	Reni region , Lenin State Farm	Danube	0,215	0,204
7	v Kislitsy, Reni district, Kirov State Farm	Danube	0,329	0,209
8	Research plots for the Rice institute, Kylia	Danube	0,269	0,269
9	v.Trudovoye, Trudovoye State Farm	Danube	0,364	0,49
10	Reni, Prydunajski State Farm	Danube	0,576	0,575
11	v.Limanskoue, Reni district, 1`st of May State Farm	Danube	0,654	0,637
12	Reni Region Collective Farms	Danube	2,324	2,112
13	v.Nahornohe, Renijsky State Farm	Danube	3,254	3,204
14	v.Desantnoye, Kiliya Region, Michurin Collective Farm	Danube	4,887	4,797
15	Kylia Region Collective Farms	Danube	7,334	6,878
16	v.Pervomayskoe, Izmail region, October Revolution Collective Farms	Danube	7,620	7,595
17	v.Lisky, State Farm Pogranychnyk	Danube	20,24	20,20
18	Kylia, Put Lenina Collective Farm	Danube	25,71	25,79
Total			74,269	73,36

Analytical control of polluted agricultural wastewater has not been enforced for most of agricultural enterprises that traditionally have been subjects for licensing. As seen from the Table 2.7. sewage water discharges of agricultural enterprises “Pogranichnik” (v.Lisky. Kiliya region) and “Put Illicha “ (Kiliya region) are comparable to industrial polluters in the river basin.

At the moment the important issue is transition from collective or state ownership to private ownership. In reality, statistical data on comprehensive assessment of size of impact of agricultural hotspots are a great deal misinterpreted. Data on number of cattle and other animals are underestimated and hardly can be compared to assessment made in Danube Integrated Environmental Studies. Practically number of private owned animals is not reported accurately in the statistical yearbooks.

2.1.2. Deletion of Existing Hot Spots

None of above listed hot spots can be deleted from the list. More over considering inevitable socio-economic growth and staring up new economic activities and industries in the region, for example sustainable tourism development, development of recreation resources, exploration of new natural resources, to update this list it is necessary to make regular inventory and foresee a tool for immediate actions to prevent appearance of the new “hot spots”. It is necessary to develop and support decision support information system and relevant databases in this field.

2.1.3. Addition of Hot Spots

Municipal "hot spots"

Based on the reports from the Regional Ecological Inspections within the Ukrainian part of the Danube River basin a few problems have been arisen. Due to insufficient or complete lack of funding for the drinking water supply and wastewater treatment facilities the epidemiological condition in the region have worsened. The most of concerns are connected with the lack of treatment facilities in the resort area where cases of bacteriological pollution of ground and surface waters were reported. The increased level of illegal emigration to Europe from Asian countries through the western Ukrainian borders can be dangerous from the epidemiological point of view in the absence of proper municipal wastewater treatment systems for small border towns. For Zakarpattia region the water quality in Uzh, Latorytsa and Tizsa are classified as III class or very polluted in terms of bacteriological pollution (Report of Zakarpattia State Ecological Inspections, 1998).

The similar problems are reported by Odessa Ecological Inspection for the Ukrainian stretch of the Kiliya branch of the river Danube concerning small settlements as Vylkovo, Kylia, Reni. Though the municipal discharges from their municipal sewer system are not very important in terms of nutrient load on the overall scale, they may impose immediate threats for the public health through discharges of pathogenic microflora.

Industrial Hotspots

Adding new industrial hot spots to the list compiled by EMIS Group is not considered as appropriate under current conditions in Ukraine. Nevertheless the important issue is enforcement of environmental legislation in the Ukrainian part of the Danube River basin and development of policy to deal with new economic situation in Ukraine industrial sector. From this point of view the institutional strengthening and technical support of ecological authorities is utmost issue for prevention of emergence of new industrial "hot spots".

Special or unusual problem situations as candidate hot spots

Currently some new problems are emerging that have not been mentioned in previous studies.

Existing pipelines of crude oil transit through the territory of Zakarpattia region impose immediate threat of oil spills to the Tisza, Latorytsa and Uzh Rivers with transboundary effects on water quality. In 1997 two big accidents have occurred in Zakarpayttia region with 16.772 m^3 a year of spilled crude oil. The accidents have occurred because of intentional drilling of pipelines by local individuals. These accidents have happened between Uzhgorod and Brody. On whole the state of pipeline "Druzhba" as has been reported by State ecological inspections of Zakarpattia region, is critical and requires urgent measures for prevention of more serious accidents.

Another problem that is rapidly becoming a great concern for the population of Zakarpattia Region is the growing number of cars and air pollution. Beside of direct impact on biodiversity of flora and fauna, this can cause higher pollution level with heavy metal and grease, oil products through surface runoff. In 1997 the emission from mobile sources amounted 60,6 % of total air emission. Those figures are not referred to the international traffic through international highways of Zakarpattia region with more than 1700 cars per day. Increasing air pollution will result in human health problem, declining of recreational capacity of the region and increase of surface runoff into the tributaries of the Danube River. This problem will require additional research study on air pollution impact on human health and the environment.

Old abandoned ships and boats at the banks of the Ukrainian Danube Delta threat vulnerable ecosystem of Danube Delta.

2.1.4. Ranking of Hot Spots

- *Municipal "hot spots"* include Chernivtsy WWTP, Uzhgorod WWTP, Kolomyia WWTP, Mukachevo WWTP, Izmail WWTP, small settlements of resort areas; small settlements of the Odessa Regions
- *Agricultural " hot spots"* include v.Lisky, social farm "Pogranychnyk", collective farm "Put Lenina", Kylia.
- *Industrial "hot spots*" include Rakhiv Cardboard Factory, Velyky Bychkiv Timber processing plant
- *Special "hot spots"* include crude oil transit pipeline "Druzhba", car traffic of transboundary highways of Zakarpattia Region; abandoned ships in the Ukrainian Danube Delta.

2.1.5. Map of Hot Spots

Figure 2.1. Hot spots and monitoring sampling sites of the Ukrainian section of the Danube River basin.

2.2. Municipal Hot Spots

2.2.1. High Priority

Table 2.8. Summary of information for the Chernivtsy WWTP hot spot

Chernivtsy WWTP	Summary of Information Used for Ranking the Hot Spot
Critical Emissions	Capacity: 285 TPE Load: 343 TPE Total BOD: 467,2 t. per year COD 966 t per year N 145,1 t per year P 18,3 t per year Chemical and Biological treatment Total discharge 33.387,9 Th. m^3 per year
Seasonal Variations	Discharge into Prut River;
Immediate Causes of Emissions	insufficient capacity of wastewater treatment facilities; poor condition of sewer system
Root Causes of Water Quality Problems	a large emissions discharge into a river with a small discharge especially in seasons with low water level
Receiving Waters	scarcity of aquatic organisms in the vicinity of the hot spot.
Nearby Downstream Uses	does not effect drinking water supply; effects ecosystem and water life of downstream rivers, recreation and sport fishing;
Transboundary Implications	may have transboundary impact on water users in Moldova and Romania
Rank	high priority

Table 2.9. Summary of information for the Uzhgorod WWTP hot spot

Uzhgorod WWTP	Summary of Information Used for Ranking the Hot Spot
Critical Emissions	Capacity: 187,5TPE Load: 297,0 TPE Total BOD: 646 t per year COD 807,5 t per year N 326,7 t per year P 130,1 t per year Nutrient discharge, bacteriological pollution Chemical and Biological treatment Total discharge 28.908 Th. m^3 per year
Seasonal Variations	Discharge into Uzh River;
Immediate Causes of Emissions	insufficient capacity of wastewater treatment facilities for current situation, poor condition of the sewer system
Root Causes of Water Quality Problems	large emissions discharge into a river with a small discharge especially in seasons with low water level; outdated technological equipment resulting in bacteriological pollution;
Receiving Waters	scarcity of aquatic organisms in the vicinity of the hot spot in Uzh river; possible pollution by pathogenic microflora
Nearby Downstream Uses	does not effect drinking water supply; effects ecosystem and aquatic life of downstream rivers, recreation and sport fishing;
Transboundary Implications	may have transboundary impact on water users in; may be a source of bacteriological pollution
Rank	high priority

Table 2.10. Summary of information for the Kolomyia WWTP hot spot

Kolomyia WWTP	Summary of Information Used for Ranking the Hot Spot
Critical Emissions	Capacity: 56,3 TPE Load: 71,3 TPE Total BOD: 149,0 t per year COD 223,0 t per year N 106,0 t per year P 34,5 t per year Chemical and Biological treatment Total discharge 6.935 Th. m^3 per year
Seasonal Variations	Discharge into Prut River; dilution factor under elaboration
Immediate Causes of Emissions	insufficient capacity of wastewater treatment facilities; potentially pollution will increase along with improvement of economic situation
Root Causes of Water Quality Problems	a large emissions discharge into a river with a small discharge especially in seasons with low water level; poor condition of sewer system
Receiving Waters	scarcity of aquatic organisms in the vicinity of the hot spot in Prut river
Nearby Downstream Uses	effect drinking water supply; effects ecosystem and water life of downstream rivers, recreation and sport fishing;
Transboundary Implications	risk of transboundary impact on water users in Moldova and Romania is very low
Rank	high priority

2.2.2. Medium Priority

Table 2.11. Summary of information for the Mukachevo WWTP hot spot

Mukachevo WWTP	Summary of Information Used for Ranking the Hot Spot
Critical Emissions	Capacity: 122 TPE Load: 86,6 TPE Total BOD: 165,1 t per year COD 206,4 t per year N 95,1 t per year P 48,9 t per year Bacteriological pollution Chemical and Biological treatment Total discharge 8.424 Th. m^3 per year
Seasonal Variations	Discharge into Latorytsa River;
Immediate Causes of Emissions	Sufficient capacity of wastewater treatment facilities for current situation, insufficient when industries will operate in full capacity; poor condition of sewer system
Root Causes of Water Quality Problems	a large emissions discharge into a river with a small discharge especially in seasons with low water level; outdated technological equipment resulting in bacteriological pollution
Receiving Waters	scarcity of aquatic organisms in the vicinity of the hot spot in Latorytsa river
Nearby Downstream Uses	does not effect drinking water supply; effects ecosystem and water life of downstream rivers, recreation and sport fishing;
Transboundary Implications	may have transboundary impact on water users in Slovakia with very low risk; may be a source of bacteriological pollution
Rank	Medium

Table 2.12. Summary of information for the Izmail WWTP hot spot

Izmail WWTP	Summary of Information Used for Ranking the Hot Spot
Critical Emissions	Capacity: 157,5 TPE Load 69,9 TPE Total BOD: 41,2 t per year COD 109,7 t per year N 213,4 t per year P 37,50 t per year Chemical and Biological treatment Total discharge 6.800 Th. M^3 per year
Seasonal Variations	Discharge into Danube River;
Immediate Causes of Emissions	sufficient capacity of wastewater treatment facilities; poor condition of sewer system;
Root Causes of Water Quality Problems	oil pollution from river port operations; discharges of untreated sewer waters
Receiving Waters	scarcity of aquatic organisms in the vicinity of the hot spot. of Danube river; oil pollution of the bottom sediments within influence of ”hot spot”
Nearby Downstream Uses	does not effect drinking water supply; effects ecosystem and aquatic life of downstream river
Transboundary Implications	may have transboundary impact on the Black Sea and Romania through bacteriological pollution
Rank	medium priority

Table 2.13. Summary of information for the Rakhiv Cardboard Factory hot spot

Rakhiv Cardboard Factory	Summary of Information Used for Ranking the Hot Spot
Critical Emissions	Total BOD: 39 t a year Phenols: no data Total discharge: 792 Th. M^3 per year
Seasonal Variations	Discharge into Uzh River;
Immediate Causes of Emissions	insufficient capacity of wastewater treatment facilities
Root Causes of Water Quality Problems	possible pollution with phenols and other organic micro pollutants; insufficient wastewater treatment because of outdated technologies
Receiving Waters	scarcity of aquatic organisms in the vicinity of the hot spot. of Prut river
Nearby Downstream Uses	does not effect drinking water supply; effects ecosystem and water life of downstream rivers, recreation and sport fishing;
Transboundary Implications	may have transboundary impact on water users in Slovakia with very low risk
Rank	medium priority

2.3. Agricultural Hot Spots

2.3.1. High Priority

This rank is not applicable under current economic situation; inventory is needed for adequate assessment of agricultural "hot spots" of high priority

2.3.2. Medium Priority

This rank is not applicable under current economic situation; additional studies is needed for adequate assessment of agricultural "hot spots" of medium priority

2.3.3. Low Priority.

Table 2.14. Summary of information for the Kylia hot spot

Collective Farm "Put Lenina"	Summary of Information Used for Ranking the Hot Spot
Critical Emissions	Total BOD: no data Phenols: no data Total discharge: 25,71 Th. m^3 per year
Seasonal Variations	no direct discharge into Danube River;
Immediate Causes of Emissions	absence of treatment facilities
Root Causes of Water Quality Problems	possible pollution of ground water; possible nutrients discharge
Receiving Waters	no available data
Nearby Downstream Uses	effect drinking water supply (ground waters);
Transboundary Implications	no available data
Rank	low priorities

Table 2.15. Summary of information for the Liski hot spot

Collective Farm “Pogranichnik”	Summary of Information Used for Ranking the Hot Spot
Critical Emissions	Total BOD: no data Total discharge: 20 Th. m^3 per year
Seasonal Variations	no direct discharge into Danube River;
Immediate Causes of Emissions	no treatment facilities
Root Causes of Water Quality Problems	nutrients discharges; bacteriological pollution
Receiving Waters	no data available
Nearby Downstream Uses	may effect drinking water supply (ground water);
Transboundary Implications	no data available
Rank	low priority

2.4. Industrial Hot Spots

2.4.1. High Priority

Under current economic situation the high priority rank is not applicable to industrial “hot spots”.

2.4.2. Medium Priority

Table 2.16. Summary of information for Velyky Bychkiv Timber Processing Plant hot spot

Velyky Bychkiv Timber Processing Plant	Summary of Information Used for Ranking the Hot Spot
Critical Emissions	Total BOD: 23,0 t per year Phenols: no data Total discharge: 839,9 Th. m^3 per year
Seasonal Variations	discharges into Tisza River;
Immediate Causes of Emissions	outdated wastewater treatment facilities
Root Causes of Water Quality Problems	possible pollution with phenol compounds;
Receiving Waters	impact on downstream aquatic life; impact of river water quality
Nearby Downstream Uses	may affect recreation and sport fishing
Transboundary Implications	may affect water quality in Hungary
Rank	medium priority

2.4.3. Low Priority.

Table 2.17. Summary of information for the Rakhiv Cardboard Factory hot spot

Rakhiv Cardboard Factory	Summary of Information Used for Ranking the Hot Spot
Critical Emissions	Total BOD: 39 t a year Phenols: no data Total discharge: 792 Th. m^3 per year
Seasonal Variations	Discharge into Uzh River;
Immediate Causes of Emissions	insufficient capacity of wastewater treatment facilities
Root Causes of Water Quality Problems	possible pollution with phenols and other organic micro pollutants; insufficient wastewater treatment because of outdated technologies
Receiving Waters	scarcity of aquatic organisms in the vicinity of the hot spot. of Prut river
Nearby Downstream Uses	does not effect drinking water supply; effects ecosystem and aquatic life of downstream rivers, recreation and sport fishing;
Transboundary Implications	may have transboundary impact on water users in Slovakia with very low risk
Rank	Low priority

Table 2.18. Summary of information for the Teresva Timber Processing hot spot

Teresva Timber Processing Factory	Summary of Information Used for Ranking the Hot Spot
Critical Emissions	Total BOD: 1 t a year Phenols: no data Total discharge: 441 Th. m^3 per year
Seasonal Variations	Discharge into Uzh River; dilution factor is under elaboration
Immediate Causes of Emissions	insufficient capacity of wastewater treatment facilities
Root Causes of Water Quality Problems	possible pollution with phenols and other organic micro pollutants; insufficient wastewater treatment because of outdated technologies
Receiving Waters	scarcity of aquatic organisms in the vicinity of the hot spot. of Prut river
Nearby Downstream Uses	does not effect drinking water supply; effects ecosystem and aquatic life of downstream rivers, recreation and sport fishing;
Transboundary Implications	may have transboundary impact on water users in Slovakia with very low risk
Rank	Low priority

3. Identification of Diffuse Sources of Agricultural Pollution

Overall review of the land use indicates the decline of area of cultivated lands on a whole in Ukraine and within the Danube River basin in particular accompanied with decrease of pesticides and mineral fertilizers applications.

3.1. Land Under Cultivation

By assessment of Ukrainian Kharkiv Center of Ecology release of nitrogen and phosphorus from agriculture within the Danube River basin was 54 % and 59% respectively of total nitrogen and phosphorus loads and had evidently declined since 1988 (54% and 67% respectively).

Table 3.1. Nutrient loads to the surface waters of the Danube River basin from agriculture

Sources	N, 1988	N, 1992	N, 1997 *	P, 1988	P, 1992	P, 1997*
	Th. tons/year		Th. tons/year	Th. tons/year	Th. tons/year	Th. tons/year
Agriculture, total	18,66	18,61	20,8	4,41	3,38	3,2
From animal farming	1,50 (4%)	1,44 (4%)		0,73 (10%)	0,54 (9%)	
From cultivated lands and grazing areas	17,17 (50%)	17,17 (50%)		3,968 (57%)	2,84 (50%)	
From forests	8,92 (25%)	8,92 (25%)		0,89 (13%)	0,89 (16%)	
Total from all sources	35,14	35,08	30	7,02	5,07	5,8

** data from Nutrient Balances for the Danube Countries (Final Report Project EU/AR/102A/91, November, 1997)*

Table 3.2. Total land (in hectares) in agricultural use in Danube River basin (Draft National Action Plan of environmental protection of the Danube River basin)

Region	Total area Th. ha	Agricultural lands	Cultivated lands	Grassing lands	Forests	Other lands
Zakarpattia	1275,3	488,70	199,9	141,3	717,3	69,3
Chernivtsi	183,4	91,30	62,3	17,3	2,8	28,0
Ivano-Frankivsk	443,66	198,07	99,82	44,36	219,25	26,34
Odessa	2,69	0,14	0,14	0	0,87	1,61
Total	1905,05	778,21	362,16	202,96	940,22	125,25

All regions within the Danube River basin reports decrease of areas of cultivated lands during the period of 1991-1996. For example the share of cultivated land of agricultural enterprises decreased from 28,1 %. The major changes are induced by the transition from the state to private ownerships.

Additionally agricultural production of major crops also decreased.

Table 3.3. Major crops production in the administrative regions of the Danube River basin in 1996-1997

	Cultivated lands	Total grain production	1997/1996	Total sugar beets production	total sunflower production
Ukraine		35397,1	+44,1	17523,1/-13,7	
Chernivtsi Region	187,9	407,6	+12,1	469,9/-16,8	3,4/-44
Ivano-Frankivsk Region	293,5	350,4	+38,2	283,7/-31,1	245,3/+30,4
Odessa Region	149,9	3335,5	+210	1410,9/-9,1	0,4/1-6,4
Zakarpattia Region	20,8	232,6	+8,0	0/0	1,7/-37,8
Total	652,1				

Table 3.3. (continued)

	Cultivated lands	potato	Vegetables	linen	fruits and berries
Ukraine					
Chernivtsi Region	187,9	313,7/-26,6	96,1/+33,5	0,1/-6,2	136,0/18,7
Ivano-Frankivsk Region	293,5	747,4/-20,0	104,6/+0,2	0,6/-44,7	98,5/+280
Odessa Region	149,9	365,3/+120	205,6/+3,4		73,8/+30,2
Zakarpattia Region	20,8	371,1/-10,5	102,5/-13,9		136,0/+18,7
Total	652,1				

By Statistic Bulletin 1997 (State Committee on Statistics. Statistic Bulletin, 1997) fuel supply in the region is still going down comparing even with beginning of 1997.

Table 3.4. Fuel supply to the agricultural enterprises of the Danube River basin regions, thousand tons

Regions	Cultivated lands in Danube basin	Diesel fuel, of January 1, 1998	% of January 1, 1997	Petroleum, of January 1, 1998	% of January 1, 1997
		Th. t		Th. t	
Chernivtsi Region	187,9	39,3	+3,1	12,8	-33,3
Ivano-Frankivsk Region	293,5	35,6	-12,5	13,0	-40,0
Odessa Region	149,9	183,3	-6,3	54,2	-9,5
Zakarpattia Region	20,8	16,0	16,7	3,9	-50,0
Total	652,1	274,2		83,9	

Table 3.5. Production of pesticides and mineral fertilizers in Ukraine

Region	Mineral Fertilizers.	N-fertilizers,	P-fertilizers	K-fertilizers	Pesticides	Application of organic fertilizers, mln. t (1997)
	Th. tons	Th. tons	Th. tons	Th. ton	tons	
Produced in Ukraine *	2326/(-0,2)	1973/+11,3	304/-20,9	48,8/+9,5	2882 / (-1677)	140,0

** State Committee on Statistics. Statistic Bulletin, 1997. Kiev*

Table 3.6. Application of organic and mineral fertilizers in the administrative regions of the Danube River basin in 1997

1997	Ukraine, total	Chernivtsi Region	Ivano-Frankivsk Region	Odessa Region	Zakarpattia Region
Application of organic fertilizers, mln. t (1997)	140,0 (276,0)	2,3 (4,0)	2,5 (6,0)	2,7 (5,6)	0,6 (1,7)
Application of organic fertilizers per ha	5,1	9,1	9,4	1,6	5,0
Application of mineral fertilizers, Th. t of active ingredient	40 (163)	65 (279)	68 (263)	26 (156)	80 (487)

Table 3.7. Application of pesticides in the Ukrainian section of the Danube River basin, tons per year

Regions	Chernivtsi Region	Ivano-Frankivsk Region,	Odessa Region	Zakarpattia Region
Years				
1980		938,34		
1985		1002,66		
1990		777,00		
1994	226,75			287,9
1995	147,45	202,00		229,0
1996	117,64	151,42		132,7
1997		62,4		116,7

In Ivano-Frankivsk region application of pesticides consists of 78% herbicides, 7 % - incsecticides, 18% fungicides and 3% - others. As of January 1, 1997 the amount of pesticides that are prohibited for application but still are stored within the region is 68,3 tons.

It is evident from the Table that in Ivano-Frankivsk Region the pesticide load per ha decreased almost 10 fold. The similar situation is expected also in other regions of the Danube River Basin in Ukraine.

Land erosion

Table 3.8. Long term trends of humus changes in the regions of the Danube River basin

Regions	Humus content, %				
	1882	1961	1981	1981/1961, %	1994-1996
Chernivtsi Region	4,0	3,4	3,0	12	2,15
Ivano-Frankivsk Region	-	2,9	2,5	14	
Odessa Region	4,2	3,7	3,3	11	
Zakarpattia Region	-	2,5	2,1	16	

Table 3.9. Eroded lands (1998) in the Administrative Regions of the Danube River Basin, thousand ha

Region	total	Agri-cultu-ral lands	slightly	%	mode-rately	%	strong-ly	%
Chernivtsi Region	143,5	59,6	91,7	38,1	40,5	16,8	11,3	4,7
Ivano-Frankivsk Region	91,1	37,0	56,4	22,9	26,9	10,9	7,8	3,2
Odessa Region	955,6	52,2	717,8	39,2	212,9	14,2	22,0	1,0
Zakarpattia Region	37,2	7,7	6,9	6,3	1,4	1,3	0,1	0,1
Total								
Ukraine, total								

Table 3.10. Cultivated lands rated by slope (Th. ha). Availability of lands

Region	available steep lands, 1995	
	total	% of total agricultural lands
Chernivtsi Region	250,0	72,3
Ivano-Frankivsk Region	259,2	62,5
Odessa Region	1113,0	56,6
Zakarpattia Region	57,2	30,7

Table 3.11. Cultivated agricultural lands, ha

Region	1996	1996
	total cultivated lands	ploughed lands
Chernivtsi Region	60,3	43,2
Ivano-Frankivsk Region	46,6	30,3
Odessa Region	82,9	66,6
Zakarpattia Region	37,5	15,8

Table 3.12. Eroded lands (by water and wind) in the administrative regions of the Danube River basin, thousand ha

Region	water erosion, total	slightly	moderately	heavily
Chernivtsi Region	200,3	103,5	57,2	39,6
Ivano-Frankivsk Region	135,9	72,1	42,7	21,1
	33,44	15,51	12,04	5,89
Odessa Region	1241,1	807,6	314,6	118,9
Zakarpattia Region	37,6	26,1	9,0	3,5
Total				
Ukraine, total	13284,2	8833,7	3218,1	1232,4

3.2. Grazing Areas

Table 3.13. Total land used for grazing in Danube catchment area and number of animals in the administrative regions of Danube River basin as of 01.01.1998

Regions	Grassing area, (Ha)	Total number of poultry	increase/decrease to January, 1997	Total number of sheep and goats	increase/decrease to January, 1997
Chernivtsi Region	210,4	3679,6	-68	65,0	-32
Ivano-Frankivsk Region	93,4	3158,6	-15	426,0	-33
Odessa Region	60,2	8835,1	-21	436,0	-23
Zakarpattia Region	120,6	2982,0	+9	125,7	-34
Total	484,6	18655,3		1052,7	
Ukraine, total		122144,5		2340	

Table 3.13. (continued)

	Grassing area, (Ha)	Total number of cattle, (thousand animals)	increase/decrease to January, 1997	Total number of Pigs (thousand animals)	increase/decrease to January, 1997
Chernivtsi Region	210,4	123,4	-22	36,82	-33
Ivano-Frankivsk Region	93,4	103,8	-25	8,7	-52
Odessa Region	60,2	332,5	-24	205,5	-15
Zakarpattia Region	120,6	53,5	-26	12,3	-27
Total	484,6	613,2		263,2	
Ukraine, total		8744,5		3666,8	

4. Updating and Validation of Water Quality Data

Selection of monitoring sites of the ambient water quality was closely related with hot spots. For the major pollution sources the monitoring sampling is performed upstream and downstream from pollution sources.

Water quantity data are usually well linked with water quantity data when sampling is performed by the State Committee of Hydrometeorology. Quality data produced by other agencies are not well connected with water quantity data.

The analytical techniques and measured variables for years 1990-1995 are presented in Annexes. These data were compiled for the Inventory of the Current Practices in Monitoring and Assessment of Transboundary Rivers under the activity of the UN/ECE Task Force on Monitoring and Assessment of Transboundary Waters (1996).

4.1. Index of Water Quality Monitoring Records

See Annex, Table 6.7.

4.2. Data Quality Control and Quality Assurance

Data Quality Control and Quality Assurance are the responsibilities of Central Analytical Laboratories of each institution involved in monitoring activities within their monitoring networks. All of them are located in Kiev.

The most common procedures for quality control are distribution to regional laboratories spiked samples or "control samples". Each analytical laboratory works by analytical techniques and by protocol approved by relevant agency. If on the whole the control system is rather efficient, many laboratories do not have modern equipment to perform a complete set of sophisticated analyses. For example, in Zakarpattia State Ecological Inspection a gas chromatograph was manufactured in 1984 in the Former Soviet Union.

The quality assurance of the analytical works is implemented through the relevant analytical protocols, established procedures of operation, and reporting system.

4.3. Data Consistency, Compatibility and Transparency

Institutions involved in monitoring are listed as follows:

- Regional State Ecological Inspections - RSEI
- State Committee of Hydrometeorology - SCHM
- State Committee on Water Management -SCWM
- Ministry of Health Care -MHC

Regional State Ecological Inspections, regional divisions of the State Committee of Hydrometeorology, State Committee on Water Management and Ministry of Health collect, analysis and produce raw analytical data. Similar analytical data in all above-mentioned agencies are performed by the standard analytical techniques approved by State Standard Service. Those data are compiled processed and reported to the relevant headquarters.

State Committee of Hydrometeorology performs the background monitoring and pollution monitoring of the water bodies and watercourses. Regional State Ecological Inspections monitor the compliance with norms and permits of discharges. The State Committee on Water Management is responsible for performing the effluent monitoring. The Ministry of Health is responsible for monitoring drinking and bathing water with emphasis on bacteriological pollution. According to Ukrainian environmental legislation, the access to the monitoring data of each agency is free.

Nevertheless under current economic constraints, the consistency, compatibility, and reliability of monitoring data somewhat decreased. For some parameters the long-term observations were disrupted, sampling frequencies and number of monitoring parameters decreased.

4.4. River Channel Characteristics

The longitudinal profiles of the rivers of the Prut River basin are predominantly *concave* with high gradients in the mountains. In main river channels in upper section of the river channel the high rocks may occur, in the Yaremcha district - lithologically originated waterfall exists. The longitudinal profiles of the rivers of Zakarpattia are rather heterogeneous: Tereblia, Rika and Tersva are concave-convex and tiered. Kosivska and other river profiles are slightly concave. The profile of the river Tisza is concave.

These types of longitudinal profiles in Carpaty Mountains are favorable for selfpurification of river discharges. In Zakarpattia lowlands the water exchange is complicated. The hydrographical network is not even (Fig 4.1.). In mountains and high lands it is rather thick, on lowlands - it is somewhat looser.

The river Tisza and its tributaries drain the southwestern macroslope of Ukrainian Carpaty. The Tisza tributaries basins are very prologated (up to the river Rika). The average altitude of watersheds are 800-1200 m, gradients are 20-30%, the width of tributaries basins varies between 10-15 m (rivers Shopurka, Tereblia, Kosivska) and 20-30 km (rivers Teresva, Rika). The rivers Borjava and Latorytsia basins have pear-like shape of 35-45 m in width. The average altitude is 300-700 m and average gradient 20-40%. The Uzh River basin is somewhat asymmetric and slightly wider in the middle part.

The river Tisza begins on the Svydovets Mountains (Black Tisza) and Rakhiv Mountains (Bila Tisza). In upper reaches it is a typical mountainous stream with V-shaped valley, narrow rocky channels and high steep covered with forest stands banks. When it flows into the lowlands the altitude decreases, the valley area increases, sometimes reaching 4 km. The river width increases to 140-260 m, and river depth up to 5-10 m. The steep and rocky banks are usually protected with dikes or have bank dams.

The river Prut flows from the Chornogog Mountains from the altitude 1600m. The Prut River basin is oval shape, somewhat wider in upper part. The approximate length of the basin is 500 m, width - 70-50 km. The river network is treelike. The average slope of upper part of river basin is 28,5%. In Carpaty Mountains the river is typically mountainous. The river channel is very undulated, width of riverbed nearby Deliatyn is 20-50 m, downstream - 100-20 m. The river depth is 0,2-1,5 m, in some places 3-4 m. The current in upper reaches is 3 m per sec., downstream – 1,0-1,3 m per sec. The river channel is rocky, with coarse pebbles, downstream - sandy riverbed. The atmospheric recharge consists up to 70 %.

The major Prut tributary is the river Cheremosh. Its river basin is of pear like shape of 50 km in upper part, and 10 km in downstream part. The average altitude of watershed is 1100 m, average slope is 32 %-33 %. The river is typical mountainous, with narrow valleys, steep, covered with forest stands slopes, rocky river channel.

4.4.1 Network.

The river network of the Carpathian tributaries of the Ukrainian section of the Danube River basin is presented at figure 4.1.

4.4.2. Channel Cross Sections

There are two gauging cross sections at the Ukrainian section of the river Danube: at the 54 miles and 115,2 miles from the river mouth. The measurements of the river depths were done August 7, 1998 at the 54th mile with the water level 214 cm above the zero level of the Reni station, and 223 cm above zero level at the 115,2th mile on August 6, 1998. These data are presented in Annexes.

4.4.3. Gradients

The Carpathian tributaries of the river Danube have different gradients along the riverbed. The upper reaches of the Carpathian tributaries of the Ukrainian section of the Danube rivers have usual very steep gradient in the very up reaches and are typical mountainous rivers (Table 4.1.).

Table 4.1. Gradients of the rivers of the Ukrainian section of the Danube River basin

River	Total altitude changes, m per km	Mean gradient	Weighted mean gradient
Tisza, lower part	10-50	5-10	
Tisza, upper part	> 50		
Black Tisza	> 50		
Latorytsia	703	3,7	1,8
Siret	435	4,4	4,1
Prut	1577	1,63	0,47
Danube	few cm		

4.4.4. Flood Plains

In Ivano-Frankivsk, Chernivtsi regions data on flooded lands for the Danube tributaries are not reported. In Odessa region the area of flooded lands is 176 ha. In Zakarpattia Region area of flooded lands is 107.500 ha.

The flood events usually occur during spring - summer seasons (mainly during April - July). For example, during last 25 years the water level in Vylkovo exceeded the flood threshold 15 times, including complete flooding of Vylkovo in February 1969.

The total area of flooded lands along the main riverbed of Danube depends upon water level (Table 4.2.).

Table 4.2. The area of flooded lands under different water level (provided the absence of anti flood constructions) in Ukrainian section of the Danube River.

Water level elevation, m	0,8	0,9	1,0	2,0	3,0	4,0	5,0	6,0	7,0
Flooded lands, Th. ha	0,0	8,4	13,7	27,0	34,2	36,8	38,0	38,4	38,7

The rivers and streams of Tisza River basin are mountainous. The spring floods are very common during snow melting. There are usually four rain floods during warm seasons. Flood consequences in the valleys of river Tisza and its major tributaries - Teresva, Tereblia, Rika, Bordjava, Latorytsa and Uzh - are very serious with big economic losses, even for floods of 50% (Table 4.3.). Catastrophic flood of the November 1998 is an evident example of such situation.

Table 4.3. Water levels of flood events in the basin of the Tisza River at the Ukrainian section of the Danube River basin

No	River	Site	Water level above the zero of observation site (cm)			
			Water level in November, 1998	flooded plains	overflow over dams	flooding
1	Tisza	Rakhiv	489	390		465
2		Velyky Bychkiv		460		
3		Tiachiv	699	250		500
4		Khust		332		
5		Vylok				
6		Chop	1328	1118	1430	1430
7	Chirna Tysza	Yasynya				
8	Bila Tusza	Luhy				
9	Kosovska	Kosovska Poliana				
10	Teresva	Ust-Chona		270		280
11		Neresnytsia		170		220
12	Mokranka	Ruska Mokra				
13	Tereblia	Kolochava		200		270
14	Rika	Verkhny Bystry				
15		Mizhgirria		400		490
16		Khust		520		534
17	Toliatynk	Maidan				
18	Repinka	Repine				
19	Pylypets	Pylypets				
20	Studenu	Nyzhny Studeny				
21	Borjava	Dovge	636	440		479
22		Shalanky	883	600	650	869
23	Latrytia	Pidpolozzia				
24		Svaliava				
25		Mukacheve	687	310		510
26		Chop				
27			746	470	835	835
28	Uzh	Zhornava		220		260
29	Uzh	Velyky Berezny				
30	Uzh	Uzhgorod	295	305	102	303
31	Turia	Symbir		220		220

During heavy rains in warm seasons the flood events are very common also for the river Siret in Chernivtsi region. The floods of 1% spread put on the 21,6 Th. ha of valley of Siret, Small Siret, and Mikhindra Rivers, floods of 5% cover 17 Th. ha, the floods over 50% occupy 2 Th. ha.

The Prut River basin within the Ukrainian territory occupies Southern and Southwestern part of the Ivano-Frankivsk region and central part of Chernivtsi region.

The mountainous landscapes, steep river gradients, frequent rains and showers are favorable for sudden and rush floods during the whole year and practically cannot be predicted. The occurrence of catastrophic floods is estimated as one event in 100 years. It has occurred in 1969.

4.4.5. Wetlands

Wetlands and swamps are distributed unevenly in Zakarpattia and occupy only 0,01% of Zakarpattia region. Most of them are ameliorated and cultivated.

In Ivano-Frankivsk Region the area of wetlands is 198 ha, in Zakarpattia Region – 82,9 Th. ha, including 0,8 ha of swamps. In Odessa Region the area of wetlands is 176 ha.

The most important wetlands of the Danube River basin are located in Odessa Region and consist of Danube Delta and wetlands of Prydunaisky Lakes (Reservoirs). They are the wetlands of international importance. Wetlands of Danube Delta are partly under Ramsar Convention. Under the GEF Biodiversity Project, the whole area is planned for imposing status of protected and should be included in the EcoCorridors. (For detail information on wetlands of Ukrainian Section of the Danube River see Annexes, also maps 2.1., 2.2., 2.3., 2.4.).

4.4.6. Erosion and Degradation

At the Ukrainian section of the Danube River basin over 35% of agricultural lands are exposed to water erosion; the wind erosion occurs only in Odessa region and amounts to 9% (84 Th. ha) of total area of agricultural lands.

The erosion processes in these regions are not well studied. The same is true for the economic losses from erosion.

By the data of the State Committee on Water Management potentially dangerous erosion is for 27% of irrigated and ameliorated lands mostly in Odessa and Chernivtsi regions. The dangerous deflatory lands consist of 45,5, 70%, and 90% in Zakarpattia, Chernivtsi and Odessa regions respectively.

In Zakarpattia region on the basins of the right bank tributaries of the river Tisza, which include lowlands and medium altitude land of the Ukrainian Carpaty and lowland lomno-alluvial plain, the erosion of ploughed lands is the highest in contact zone of these lands.

The highest portion of the eroded agricultural lands is located in Irshava and Mizhgirria districts (29%), average size of eroded agricultural lands (11-14%) is in Volovets, Rakhiv, Svaliava, Tiachiv, and Uzhgorid regions, and the smallest portion of eroded agricultural lands of Zakarpattia region is located in Berehiv, Vinogradiv, Tiachiv, and Khust districts. The similar situation is observed for ploured agricultural lands.

One of the important effects of the erosion is sedimentation, pollution and depletion of the water sources.

To combat erosion and deflation it is necessary to plant over 27,1 Th. ha of forest stands, to built erosion preventive constructions, to arrange terraces, etc.

These activities will require additional funding, which is difficult to provide under current economic conditions.

4.5. Dams and Reservoirs

The whole system of the reservoirs at the Ukrainian section of the river Danube is not significant. The types and major parameters of the reservoirs of the Ukrainian section of the Danube River basin are presented in Table 4.4. and Table 4.5.

Table 4.4. Reservoirs of the Ukrainian Section of the Danube River Basin

Type of reservoirs	Number of reservoirs	total water volume under normal conditions	area of water table
Large reservoirs, more than 10 ml. m^3	6, including 4 of capacity more than 100 ml. m^3	1236,0	282 km^2
Reservoirs, less than 1 ml. m^3	33	1308,0	530,6 km^2
Ponds	602	56,5	38,3 km^2

Table 4.5. Major reservoirs of the Ukrainian section of the Danube River basin

Large reservoirs (lakes)	River basin	Area, Ha	Capacity, ml. m^3		Comments
			normal	working volume	
Yalpug-Kugurluj, Izmail Region	Danube, Yalpug, Karasulak	2680	670	210	
Kutayi, Kylia Town	Danube, Kirgizh-Kytaji, Yenika	6000	125	52,5	
Katkabukh, Kylia Town	Danube, Velyktj Katlabukh, Tashbunar, Yenika	6850	131	68,5	
Sasyk, Prymorske village	Sarata –Kogylnyk	20800	530	235	connected with Danube through canal
Tereblia, Rakhiv town	Tysa, Tereblia	155	24,0	5,0	hydropower

In Zakarpattia region 122 small dams, 13 reservoirs with useful capacity 22.5 mln m^3, Tereblia-Rikhska power station, many ponds on small streams are constructed. In Odessa region area of lands under dams (or bank protection) is 1500 ha.

The reservoirs at the river Tisza do not influence the river flood. There are a few reservoirs in the Prut River basin with additional volume for flood regulation, but their influence on floods is low.

The effect of reservoirs on floods is evident for flood of 5 % and more and their permanent discharges 700 m^3 per sec. The floods of lower hydraulic loads are regulated in much less degree.

The regulatory capacity of Danube lakes-reservoirs is limited and practically does not influence flood events. Existing constructions, canals and waterlocks are outdated and are not efficient even for minimal requirements. Even small floods may destroy them and large areas may be flooded.

Locations of reservoirs and ponds as well as major flood protective construction are presented on Maps 2.1., 2.1., 2.3., 2.4., also see 4.2., 4.3.

4.6. Other Major Structures and Encroachments

Hydraulic constructions are mainly presented by irrigation systems in Odessa and antiflood constructions in Zakarpattia region. In Ivano-Frankivsk and Chenivtsy Region these constructions are less important. (Table 4.6.; 4.7.).

Table 4.6. Area of irrigated and ameliorated lands (Th. ha) at the Ukrainian section of the Danube River basin.

River basin	Irrigation area, Th. ha	Amelioration area, Th. ha
Danube (Odessa region)	97,06	0,00
Tisza (Zakarpattia region)	2,97	66,26
Larotytsia (Zakarpattia region)	3,10	11,93
Uxh (Zakarpattia region)	0,00	2,41
Siret (Chernivtsi region)	0,92	35,20
Prut (Ivano-Frankivsk region)	1,62	53,20
Prut (Chernivtsi region)	5,08	62,47
Kagul (Odessa region)	7,03	0,00
Yalpukh (Odessa Region)	17,30	0,00
Total	134,50	331,50

Table 4.7. The largest irrigation systems of the Ukrainian section of the Danube River basin

Name	Area of irrigated lands, Th. ha
Tatarbunary irrigation system	30,7
Suvorovo irrigation system	10,0
Chervonoyarsk irrigation system	7,5
Danube-Dnister irrigation system	5,0
Kiliya irrigation system	4,8
Izmail irrigation system	3,8

In Odessa Region there are 16 pumping stations for irrigation, one pumping station of group water supply system and water intake stations of Izmail, Kiliya, Vylkove. Additionally, there is a sector water intake in the village Salmany.

Major irrigation systems of Odessa Region along the Danube River are: Prydunaiska Irrigation system; Bolhrad Irrigation system; Suvorovo Irrigation System and Tatarbunary Irrigation System. 300,6 km of dams are constructed along Danube riverbank. The dam through canal Danube Sasyk is 14 km long.

In Zakarpattia Region the irrigation systems and irrigation canals are not available.

In Ivano-Frankivsk Region area of irrigation canals is 294 ha and has 1970 m of water routes.

The major flood protection constructions are presented in Table and at the Maps.

The regulation of flood with system of reservoirs was not accepted for Transcarpathian Regions because of high costs of construction and long expenditure return period (between 25 and 100 years) (Table 4.8.).

Table 4.8. Flood routing and hydraulic constructions.

River basin, river	Region	River length within the region, km	Dikes	River channel strengthening	bank protection	embankments
Tisza river basin	Zakarpattia Region					
Tisza	Zakarpattia Region	201	127,9	3,7	73,4	
Teresva	Zakarpattia Region	56	14,00	1,1	12,0	
Tereblia	Zakarpattia Region	91	3,5		7,0	
Rine	Zakarpattia Region	92	11,7		11,1	
Borjava	Zakarpattia Region	106	38,7	2,7	6,5	
Latorytia	Zakarpattia Region	144	104,2	45,7	10,0	5,0
Uzh	Zakarpattia Region	107	10,1		18,9	3,4
Small rivers, brooks, canals	Zakarpattia Region	452,8	96,9	391,0	19,2	
Total		1249	407,0	444,2	168,1	8,4
The Siret River Basin						
Siret	Chernivtsi region	100	5,1			
Tributaries of Siret		122,5		75,7	5,4	
Total		222,5	5,1	75,7	2,6	
					8,0	
The Prut River Basin	Chernivtsi region					
Prut		128,0	11,7		28,4	0,7
Tributaries of Prut		439,3		183,1		
Cheremosh	Chernivtsi region	80	46,7		1,3	
Tributaries of Cheremosh		24,8		9,8		
Prut	Ivano-Frankivsk region	160	12,4	3,0	12,1	
Tributaries of Prut		210	16,3	4,6	3,2	
Cheremosh	Ivano-Frankivsk region	80	27,8	10,0	2,8	
Total		1122,1	114,9	210,5	47,3	0,7
Danube, Ukrainian section		170,2	285,8	25,8		10,8
Other rivers		2420,0		369,0		
Total		2590,2	285,8	394,8		10,8
Prut, Yalpug, Sarata	Moldova	877	262,9		40,0	
Total		6061,6	1075,7	1125,2	263,4	19,9

** Statistics of the State Committee on Water Management*

In 1992 the overall water withdrawal from Danube was 1362,3 ml. m^3 per year; discharge into the river Danube – 246,8 ml. m^3 per year. Water transfer from Danube River through the canal Danube - Sasyk is 833 ml. m^3 per year.

For the Danube tributaries the questions are not applicable.

Since 1990, the new bank protection and flood preventive constructions were built in very limited numbers due to lack of sufficient funding. The scarce resources were allocated merely to maintain already existing constructions. The catastrophic flood on the Tisza River in November, 1998 resulted in large economic losses, effected people health, caused human deaths and showed the importance of improving of these activities and needs in international financial assistance. For example, only in Ivano-Frankivsk region the bank protection construction should be built as follows from the Table 4.9.

Table 4.9. Bank protection in Ivano-Frankivsk region to be done in the following districts

District	River	Length of protection
Naddvirniandky	Prut	25
Kolomyisky	Prut	26
Verkhovynsky	Cheremosh	30
Sniatynsky	Prut	56
Kosivsky	Cheremosh	74

The current State Programme on Flood Prevention cannot be fully implemented due to extremely difficult economic constraints.

4.7. Preferred Sampling Stations and Data Sets

At Ukrainian territory of the Danube River the only stations included in TNMN are Izmail and Vylkovo. For these two sampling cross sections the measurements of the river flow and water quality are made simultaneously.

For all other sampling stations the water quality data are given from the nearest sampling point existing within the monitoring network of the Regional State Ecological Inspections, and sampling point of the State Committee of Hydrometeorology routine monitoring networks. Data on effluent discharges may be obtained from the State Committee on Water Management within their monitoring network and enterprises that have the responsibilities for self-control of hazardous compounds.

At the following stations the simultaneous measurements of water flow and concentrations of variables were performed.

Danube river - Vilkovo, Izmail, Reni
Tisza river - Khust, Rakhiv, Tiachiv, Vilok
Uzh river - Uzhgorod
Prut river - Chernivtsi, Kolomyia

The number of measurements is given in Annexes.

4.8. Water Discharges

The Danube and its major tributaries water discharges are presented on the Figures 4.4., 4.5., 4.6., 4.7. and Table 4.10.

The annual course of river discharge is typical for the temperate geographical zone with 2 peaks: major - spring flood in March-April-May and secondary (rain floods) in the fall.

Monthly average river discharges are presented in Annexes.

Table 4.10. Average annual, maximal and minimal river discharges for Ukrainian territory of the Danube River basin

Danube	Vilkovo (1 km downstream)			Izmail (1 km downstream)			Reni (1 km downstream)		
m^3/s	1994	1995	1996	1994	1995	1996	1994	1995	1996
Average per year	0,89	1,96	1,92	0,74	1,91	1,89	0,82	1,69	1,66
Max	1,50	2,40	2,80	1,75	2,50	2,80	1,65	2,60	2,50
Min	0,26	1,30	1,20	0,13	1,00	0,96	0,15	0,58	0,98

Table 4.10. (continued)

Tisza	Khust (4 km upstream)			Rakhiv (0,5 km downstream)			Tyachiv (9 km upstream)			Vilok (in village)		
	1994	1995	1996	1994	1995	1996	1994	1995	1996	1994	1995	1996
Average per year	268,00	180,75	100,00	9,25	21,63	9,30	170,26	197,00	84,20	37,15	157,68	119,00
Max	338,00	247,00	110,00	9,80	38,40	9,30	466,00	280,00	92,70	65,00	362,00	131,00
Min	188,00	95,00	90,00	8,70	11,60	9,30	40,00	106,00	75,70	3,80	36,70	107,00

Table 4.10. (continued)

Uzh	Uzhgorod (2 km downstream)		
	1994	1995	1996
Average per year	23,42	25,82	15,67
Max	42,20	80,70	35,90
Min	5,60	3,70	4,66

Table 4.10. (continued)

Prut	Chernivtsi (3 km downstream)			Kolomiya (0,5 km downstream)		
	1994	1995	1996	1994	1995	1996
Average per year	50,69	70,79	30,90	10,09	20,85	
Max	127,00	187,00	70,00	22,00	26,00	0,00
Min	21,60	26,10	16,70	3,50	15,70	0,00

Figure 4.4.

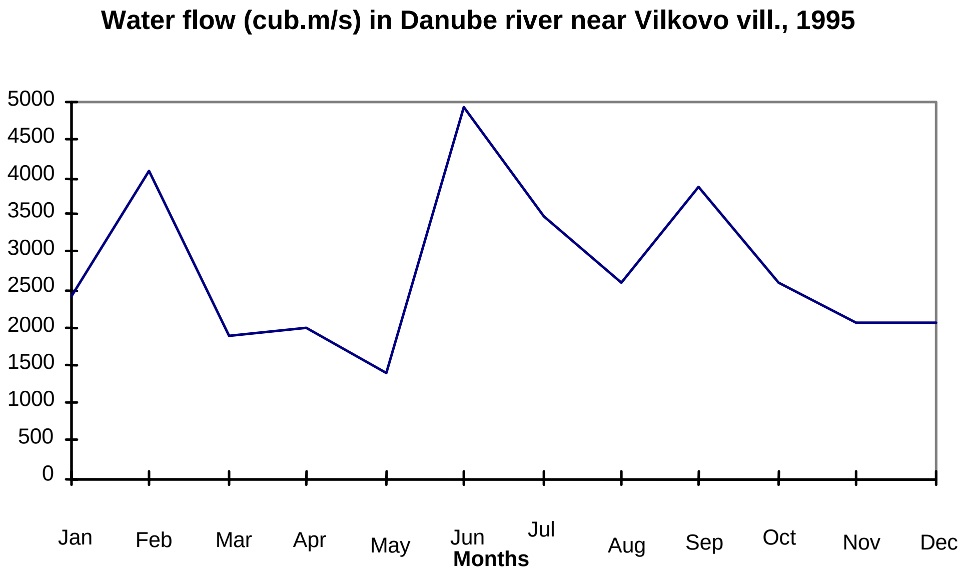


Figure 4.5.

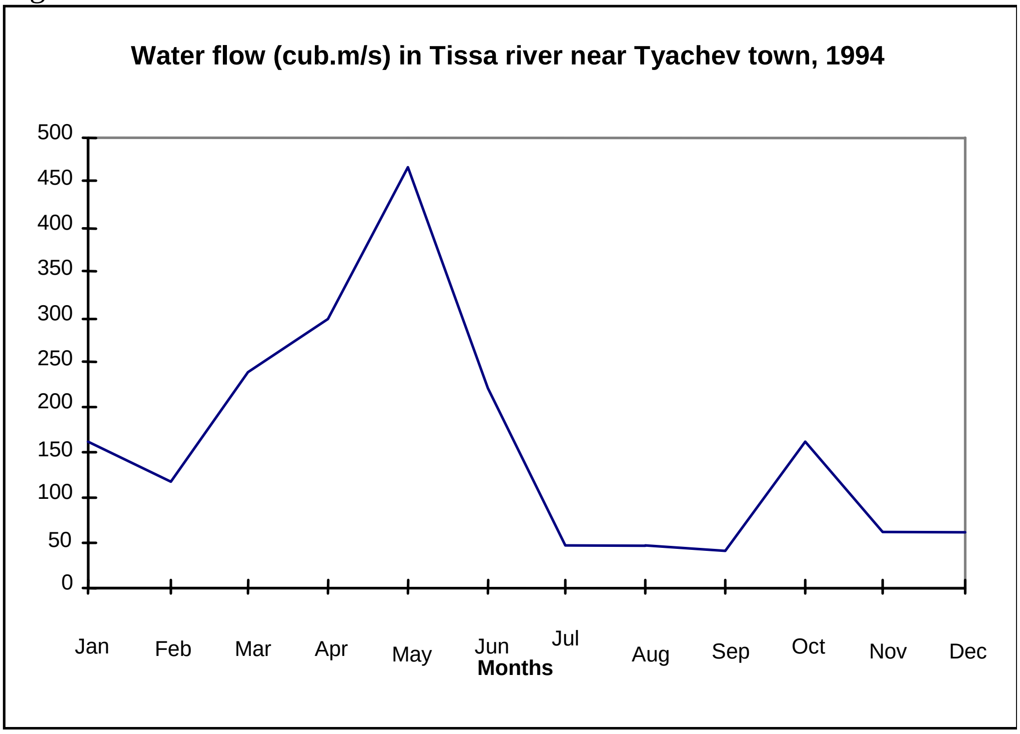


Figure 4.6

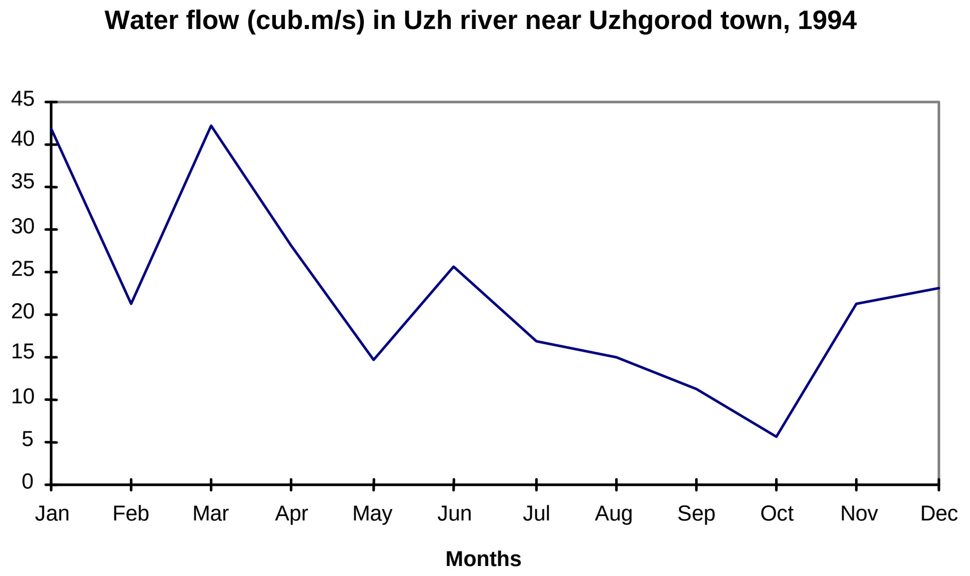
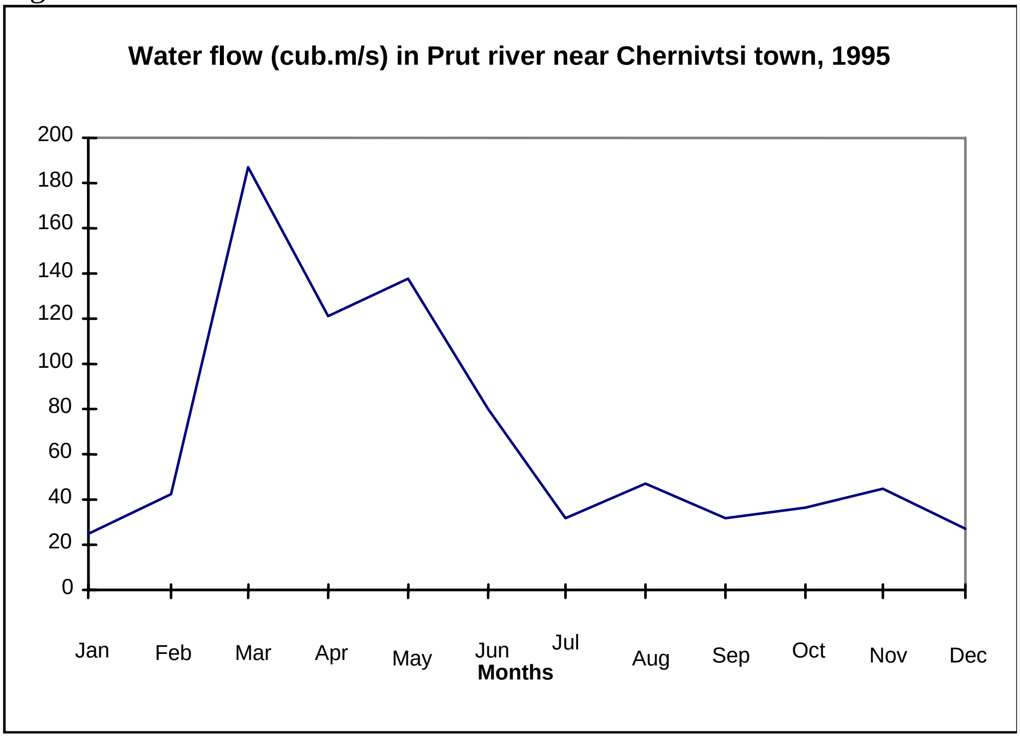


Fig 4-7



4.9. Suspended Solids Discharges

The rivers Prut and Siret drain the southeastern part of Ukrainian Carpaty. The average annual discharge of suspended solids in the river Prut basin amounts up to 49-241 ton per km^2 per year, 30-39 ton per km^2 per year in Cheremosh River basin, 119 ton per km^2 per year in the Siret River basin. The high rate of human induced denudation, calculated by suspended solid discharges, occurs in the stream river basins with high human pressure (for example, Siret River basin).

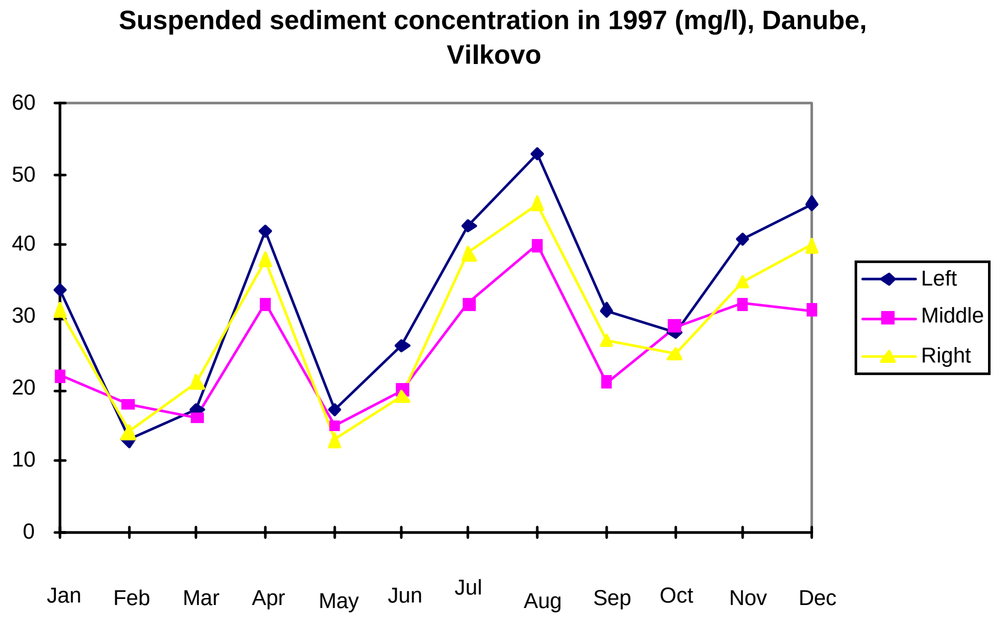
The rivers Tisza, Latorytsia and Uzh have high-suspended solids discharges in many cases exceeding 100 ton per km^2 per year. Only in upper reaches of Tisza, Tereblia and Borjava it varies between 71-105 ton per m^2 per year. In the other river basins the suspended solids discharges vary between 11-384 ton per km^2 per year.

The sediments of the majority of the rivers consist of the 5-10% particles with 0,5-1,0 mm in diameter. The highest turbidity is reported for mountainous parts (up to 500-750 g per m^3). The movement of bottom sediments is not sufficiently studied for the rivers of Western Ukraine. It is reported that transport of bottom sediments consists of 10 -15 % of suspended solids. In mountainous and semi-mountainous rivers this ratio may reach 70-90% and exceeds suspended solids transport by 2-3 times.

4.10. Content of the Suspended Solids

Content of the suspended solids in the Danube water (Vilkovo) is presented in the Fig. 4.8. Maximal content of suspended solids is observed during the summer seasons, and because the rivers are not covered with ice during winter periods. Small peaks in springtime are related to the spring flood events.

Figure 4.8.



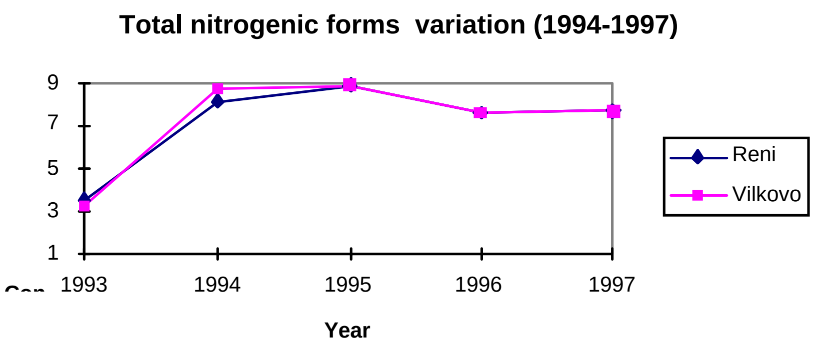
4.11. Water Quality

Data on water quality for Danube River and its major tributaries are presented in the ANNEXES. Completeness and duration of observations are presented in Annexes.

4.11.1.Nitrogen

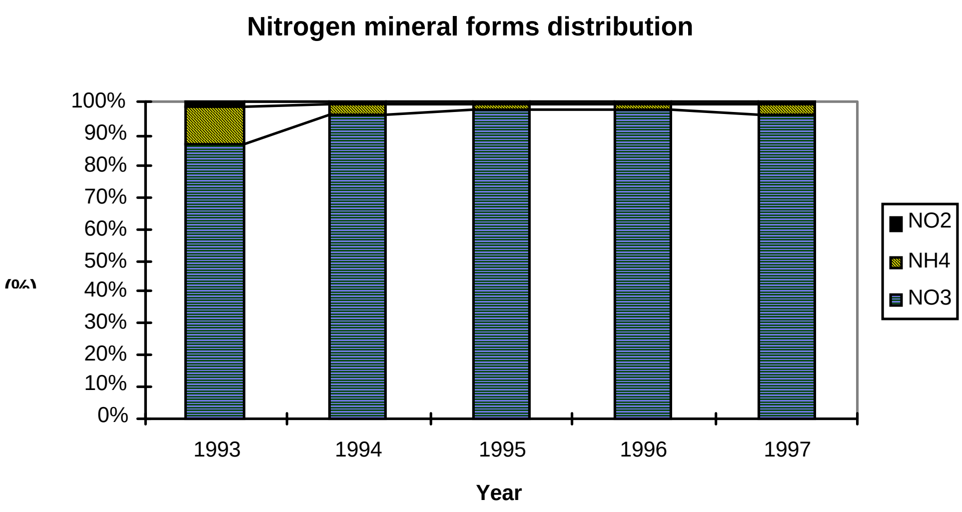
Monitoring data are presented only for mineral species of nitrogen meanwhile the total nitrogen content including mineral and organic species have not been analyzed. Average annual concentration of the mineral species of nitrogen (sum of mineral species) in the Danube water varied between 1,39 and 0,51 mg/L with maximal concentrations 2,8 mg/L (Vylkovo and Izmail, 1996). By the monitoring data of the State Ecological Inspection the annual average nitrogen content was 9 mg/L mostly as nitrates (Fig. 4.9.).

Figure 4.9.



The distribution of mineral nitrogen species is presented on the Fig. 4.10. It is evident that the portion pf ammonium and nitrites decreased significantly during last three years. The highest concentrations of nitrates were recorded in 1994 and 1995 reaching 13 - 14mg/L. Usually the highest nitrogen content is accompanied by high water discharges.

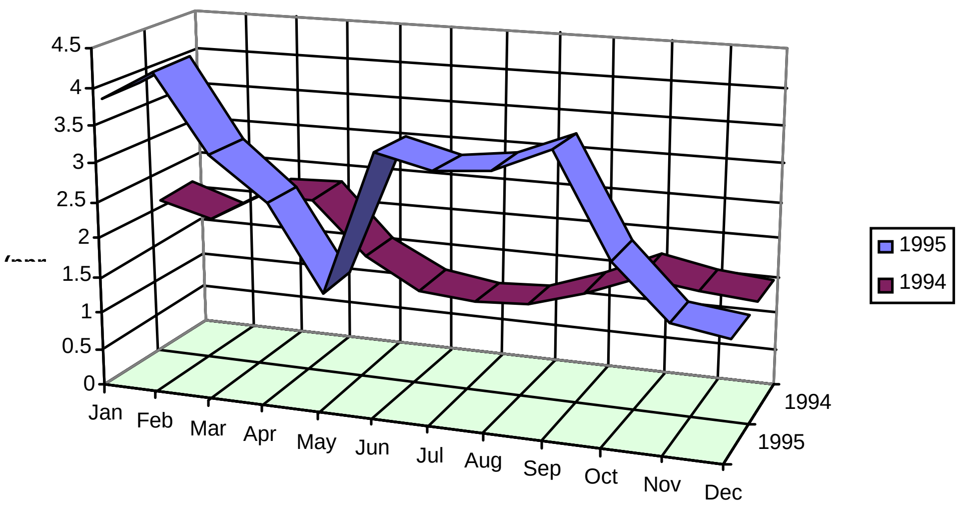
Figure 4.10.



The content of mineral nitrogen species in the major Danube tributaries ranges between 0,10 and 6,0 mg/L for Tizsa River, 0,92 - 4,2 mg/L for Uzh River and 0,37 - 5,9 mg/L for Prut River. Long term trend of mineral nitrogen is reversibly related with water level. The prevailing concentrations are between 2,5 and 4,3mg/L with domination of nitrates and ammonium. The less abundant are nitrites.

Figure 4.11.

N (miner. forms) content in Uzh water, Uzhgorod town

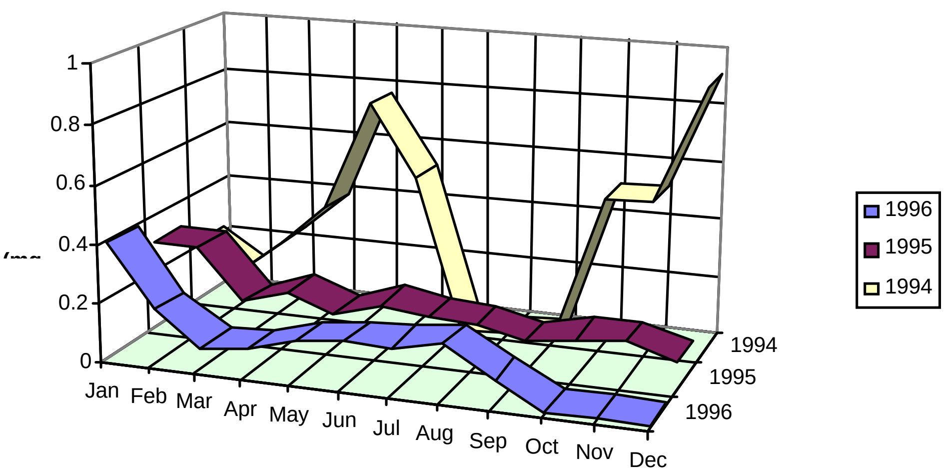


4.11.2. Phosphorus.

The monitoring data are presented only for total phosphorus (data of the hydrometeorological station) for a period 1994 -1996. Average concentration of total phosphorus in the Danube water varies between 0,14 - 0,47mg/L, with a range 0,06 - 1 mg/L. While in 1994 the changes of total phosphorus follow the changes of river discharges, later became more stable (Fig. 4.12.).

Figure 4.12.

Phosphorus content in Danube water, Ismail town



The phosphorus content in the major Danube tributaries is evidently lower than in Danube.

Table 4.11. The variations in phosphorus content for the Danube tributaries

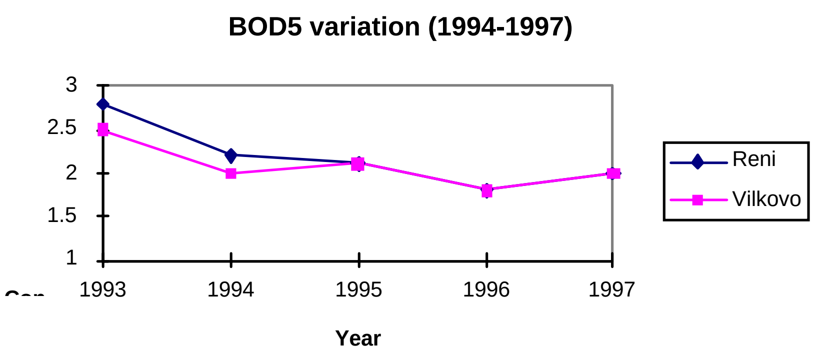
	Total phosphorus, mg/L		
	Average annual	Maximum	Minimum
Tisza	0,08 - 0,13	0,51	0,01
Uzh	0,08	0,09	0,06
Prut	0,14-0,17	1,00	0,03

4.11.3. COD and BOD

The most comprehensive monitoring data exist for BOD 5 that creates a good base for long-term trends assessment of organic pollution.

Long term trend of BOD 5 changes is presented in the Fig. 10. that reveals the evident decrease of this variable. It can be explained by reduction of discharges of easily oxidized organic matter with industrial discharges due to decline of industrial output. Seasonal BOD 5 variations in 1997 are presented on the Fig. 4.13. that shows increase of readily available organic matter during high water periods.

Figure 4.13.

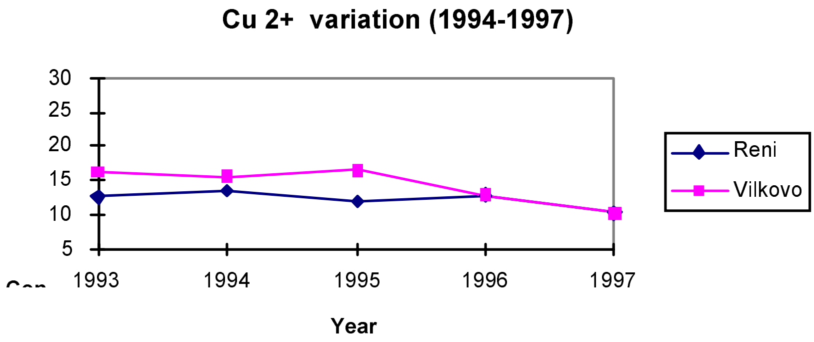


BOD5 is rather stable in the Danube tributaries: 2-5,3 mg/L for Tisza River (primarily 4 mg/L), 2 - 5,7 mg/L with average 2,64 mg/L for Uzh, and 2 - 5,3 mg/L (average 2,65 - 3,75mg/L) for Prut.

4.11.4.Heavy Metals

Hydrometeorological monitoring network in Ukraine has rather complete and long-term observations only for copper, chromium, and zinc. At the same time ecological inspections monitor copper, zinc, manganese, lead, nickel, chromium and iron. Long term trends in heavy metals contents is relatively stable for copper and chromium and slightly less stable for manganese and zinc. During the last two years the content of zinc and manganese have increased significantly.

Figure 4.14.



Seasonal variations of the heavy metals contents are very typical with elevated concentrations during spring-summer that might be explained by corresponding variations of suspended solids content and other natural processes in water bodies. According to the water quality criteria maximum allowable concentrations of copper and chromium are 1 mkg per L, and 10 mkg per L for zinc, lead, and manganese.

Figure 4.15.

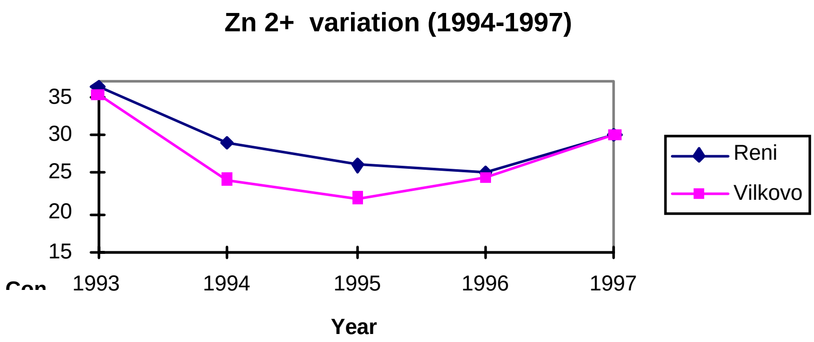
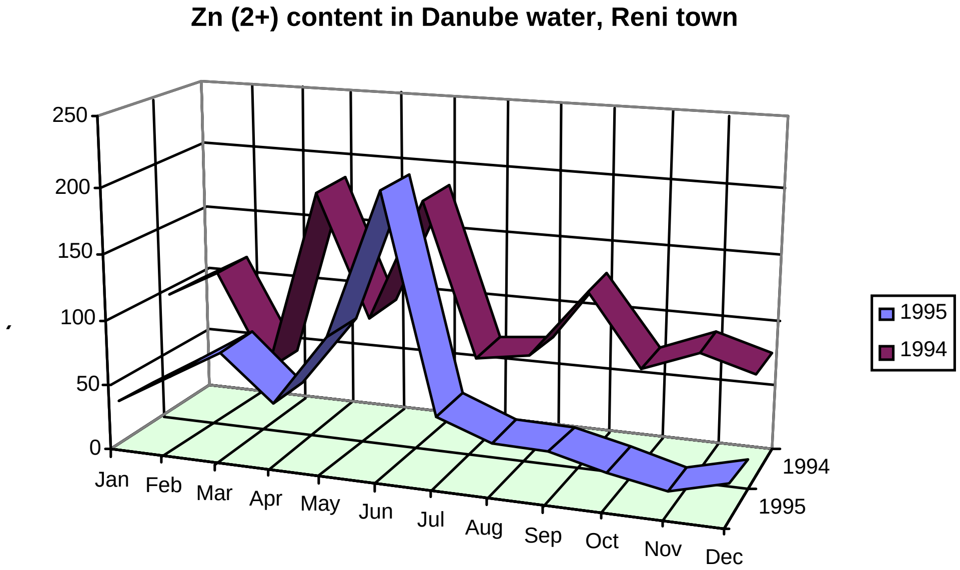


Table 4.12. **Annual average concentrations of heavy metals in the water of the river Danube, ppm**

Year	Fe	Cu	Zn	Mn	Pb	Ni	Cr
1994	0,2442	14,417	26,653	14	10,236	1,4958	6,4347
1995	0,2493	14,292	24,139	14,611	10,722	1,4806	6,2472
1996	0,2255	12,879	24,864	13,212	11,227	1,5	6,7758
1997	0,23889	10,4306	30,0556	22,5556	10,5	1,575	6,29444

Figure 4.16.



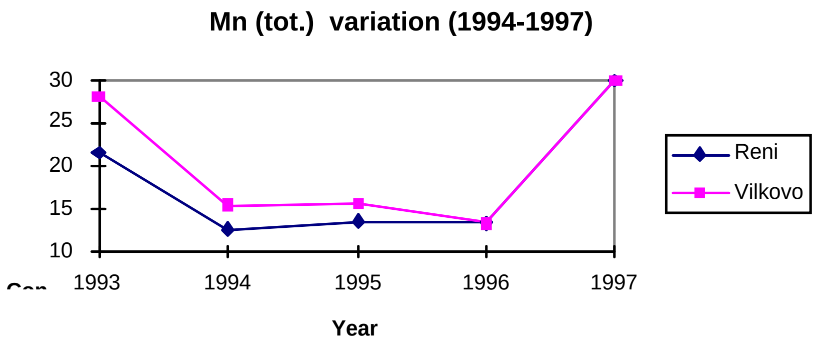
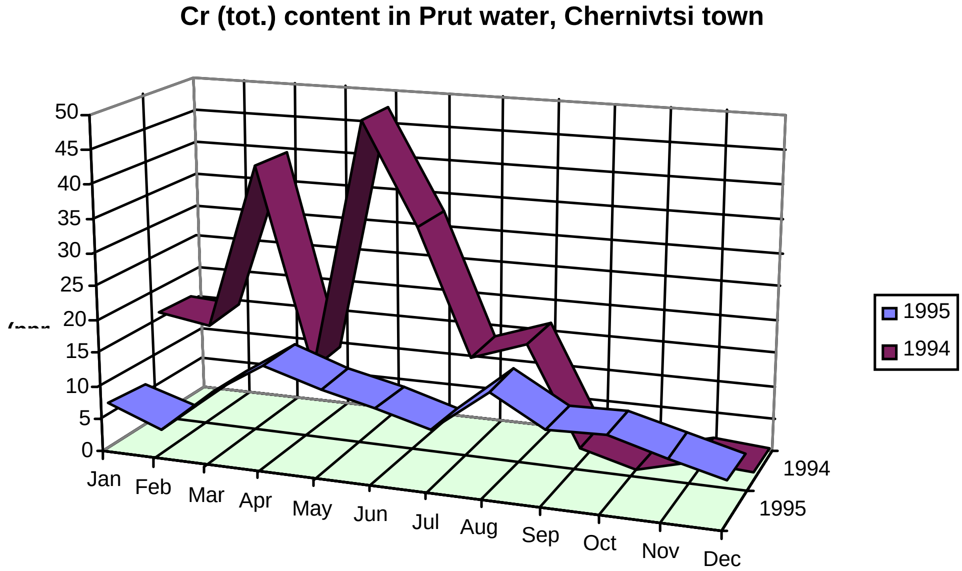


Figure 4.17.

Variations of the heavy metals content in the major tributaries of the river Danube are much more significant, especially for zinc (65 - 132 mkg/L in Tisza, 0 - 92 mkg/L in Prut) and chromium (2,1 - 39mkg/L for Tisza, 1,6 - 75,8 mkg/L for Uzh, 0 - 48 mkg/L for Prut). While there are not available data on copper concentrations in Tisza and Uzh, the data on copper content varies significantly in water of the river Prut nearby the city Chernivtsi. These elevated levels of the heavy metals (comparing to the existing standards) affect the water quality for recreation and fisheries uses.

Figure 4.18.



.

4.11.5. Oil Products and Phenol Compounds

Oil pollution has been monitored by ecological inspections as well as by hydrometeorological stations. Long term trends in oil pollution are presented at the Fig. 4.19. Elevated level of oil pollution in Kiliya Branch of the river Danube has in the most of cases the transboundary origin, including the impact from the river Prut. Concentration of oil products in the Danube water varies (see Table 4.6.):

Figure 4.19.

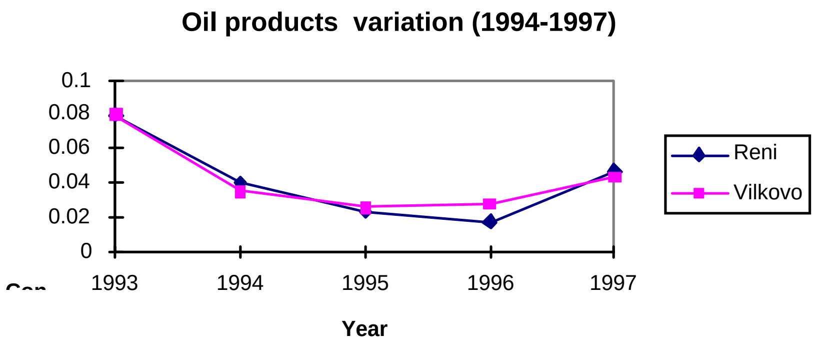


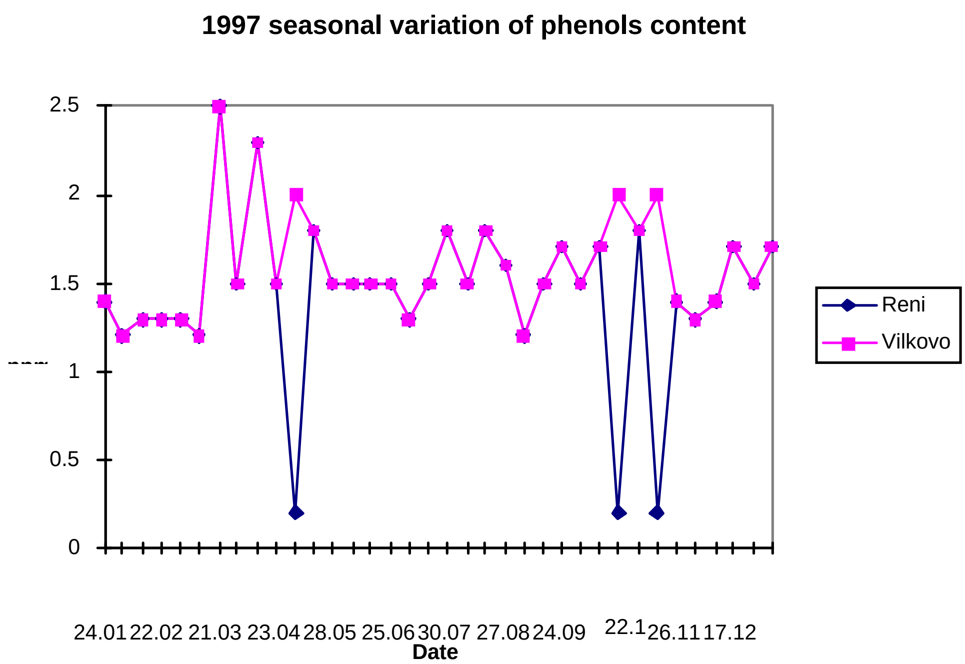
Table 4.13. Concentrations of pollutants in the water of Ukrainian section of the river Danube

	Oil products	Phenols	Oil products	Phenols	Oil products	Phenols	Oil products	Phenols
Years	1993	1993	19994	1994	1995	1995	1996	1996
Average	0,0392	1,404	0,025	1,197	0,029	1,271	0,0456	1,5139
Max	0,08	1,8	0,046	1,5	0,045	1,5	0,07	2,5
Min	0,014	1	0,015	1,1	0,018	1	0,018	0,2

Concentrations of oil in the water of Ukrainian Section of the river Danube between 0 and 0,30 mg/L with average concentrations 0,08 - 0,11mg/L (data of the State Committee on Hydrometeorology). According to existing assessment criteria the oil polluted water (more than 0,05 mg/L) are not acceptable for fish reproduction when pollution events occur regularly.

Phenol pollution is much more serious because the minimal concentrations of these compounds are equal or higher than maximum allowable concentrations for fisheries and sanitary-hygienic uses. Seasonal variations of phenol contents (See Fig. 4.20.) are not significant with small peaks during spring and summer flood events. As can be seen on the Fig. 4.20. big share of phenol pollution is released from the territory of Ukraine at the section between Reni and Vilkove.

Figure 4.20.



There are not available data on content of phenol compounds in the major tributaries of the Danube.

4.11.6. Special Linkages

Not applicable.

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

All issues related to water quality control and management are regulated by Water Code of Ukraine of 1996.

National, international and regional programmes on water resources use, protection and restoration are developed in order to provide implementation of effective measures for satisfaction of domestic and industrial water needs, rational use and protection of waters, prevention of their adverse action.

National, international and regional programmes on water resources use, protection, and restoration are developed on a base of data of state water accounting, water cadaster, schemes of water resources use, protection, and restoration, etc.

Development and implementation of these programmes are funded by the national budget of Ukraine, budget of the Autonomous Republic of Crimea and local budgets, resources of enterprises and organizations, off-budget funds, voluntary donations of organizations and citizens, and other budgets.

The state management of water resources use, protection, and restoration is carried out according to the river basin principle on the basis of national, international, and regional programmes for water resources use, protection, and restoration.

The state management of water resources use, protection, and restoration is carried out by the Cabinet of Ministers of Ukraine, Government of the Autonomous Republic of Crimea, local radas of people's deputies and their executive committees, bodies of the state executive power, specially authorized bodies, and other state bodies according to the legislation of Ukraine.

Specially authorized bodies of the state executive power in the area of water resources use, protection, and restoration are as follows: the Ministry of Environmental Protection and Nuclear Safety of Ukraine; the State Committee for Water Resources, the State Committee on Geology and Utilization of Mineral Resources of Ukraine, their local bodies and other state bodies according to the legislation.

Their powers are:

- setting up priorities of water usage;
- providing development of national, international and regional programmes for water resources use, protection, and restoration; approving regional programs;
- determination of procedure for state executive bodies' action in the area of water resources use, protection, and restoration; coordination of their activities;
- establishing procedure for issuing permits for special water use, constructing, dredging and blasting, mining sand and grit, laying cables, pipelines and other supply lines within lands of the Water Fund, as well as for development and approval of standards for discharge of polluting substances into water bodies;
- establishing norms of payments for special water use and procedure for collecting these payments;
- establishing norms of payments for use of waters for hydropower generation and water transport needs, and procedure for collecting these payments;
- making decisions regarding discharge of wastewater from storage tanks into water bodies in case of emergency situations, when it leads to exceeding of admissible concentrations in these water bodies;
- organization and coordination of work on prevention and mitigation of consequences of accidents, emergency, adverse effect of waters or worsening quality of water resources;

- making decisions on limiting, temporary prohibiting (terminating) or suspending activity of enterprises, institutions, and organizations in case of violation of water legislation, within its jurisdiction;
- approving of designs for sanitary protection zones of communal-drinking water intakes that provide water supply for territory of more than one oblast;
- management of external relations of Ukraine concerning water resources use, protection, and restoration;
- dealing with other issues of water resources use, protection, and restoration.

Powers of the Ministry of Environmental Protection and Nuclear Safety in the area of management and control of water resources use, protection, and restoration include:

- carrying out complex management of water resources protection; conducting unified scientific-technical policy in the area of water resources use, protection, and restoration; coordination of activity of ministries, departments, enterprises, institutions, and organizations in this field;
- exercising government control of water resources use, protection, and restoration;
- development and participation in implementation of national, international, and regional programmes on water resources use, protection, and restoration;
- organizing and conducting state monitoring of water resources;
- development and approval of standards and rules; participation in development of standards concerning management of water resources use, protection, and restoration, within its jurisdiction;
- conducting the state environmental impact assessment;
- issuing permits for special water use, when the water is used from water bodies of national significance;
- making decisions on limiting, temporary prohibiting (terminating), or suspending activity of enterprises, institutions and organizations, according to the established procedure, in case of violation of water legislation, within its jurisdiction;
- development and implementation of organizational-economic measures on providing protection and use of waters and water resources restoration, according to the established procedure;
- carrying out international cooperation regarding issues of water resources use, protection, and restoration;
- dealing with other issues concerning water resources use, protection, and restoration.

Article 16. Powers of the State Committee on Water Resources in the Area of Management and Control of Water Resources Use, Protection, and Restoration

Powers of the State Committee on Water Resources in the area of management and control of water resources use, protection, and restoration include:

- conducting radiological and hydro-chemical monitoring of water bodies of complex use, water-supplying systems of inter sector and agricultural water supply;
- conducting control on compliance of reservoirs' and water-supplying systems' operation with established operational regime;

Powers of the State Committee of Geology and Utilization of Mineral Resources of Ukraine in the area of management and control of water resources use, protection, and restoration include:

- conducting the state monitoring of ground waters;
- carrying out the state geological control on investigation and other activities regarding geological study of ground waters;

State Water Monitoring

State water monitoring is conducted with purposes of providing collecting, processing, storage and analysis of information about the state of waters, predicting its changes, and development of scientifically substantiated recommendations for making managerial decisions concerning water resources use, protection, and restoration.

State monitoring is a part of the national system of environmental monitoring of Ukraine and is conducted according to the procedure determined by the Cabinet of Ministers of Ukraine.

Environmental Impact Assessment Survey

State, public and other environmental impact assessment surveys are conducted according to established procedure, with the aim of providing ecological safety when placing, designing, and building new and/or reconstructing existing enterprises, buildings and other facilities, related to usage of waters.

Annexes

Table 6.1. Danube River Cross Section at 54th mile and 115.2th mile

Izmail, Danube cross section, August 7, 1998, 54th Mile

No	The working depth, m	Distance from the observation site, m	Depth between verticals, m	Distance between verticals, m	The crosssection area, m^2
1	0,00	10,70	3,55	8,00	28,40
2	7,10	18,70	10,00	12,00	120,00
3	12,90	30,70	14,95	12,50	186,88
4	17,00	43,20	17,85	24,70	440,90
5	18,70	67,90	18,55	7,90	146,55
6	18,40	75,80	10,17	10,30	176,13
7	15,80	86,10	12,85	14,90	191,47
8	9,90	101,00	10,90	1,00	10,90
9	11,90	102,00	7,75	11,00	129,25
10	11,60	113,00	11,00	5,00	55,00
11	10,40	118,00	9,75	6,00	58,50
12	9,10	124,00	9,75	8,00	78,00
13	10,40	132,00	10,20	1,00	10,20
14	10,00	133,00	8,85	2,00	17,70
15	7,70	135,00	8,65	8,00	69,20
16	9,60	143,00	9,60	5,00	48,00
17	9,060	148,00	9,50	1,00	9,50
18	9,40	149,00	9,20	13,00	119,60
19	9,00	162,00	8,65	6,00	51,90
20	8,30	168,00	8,30	5,00	41,50
21	8,30	173,00	8,45	11,00	92,95
22	8,60	184,00	8,60	0,00	0,00
23	8,60	184,00	8,15	14,00	114,10
24	7,70	198,00	7,80	1,00	7,80
25	7,90	1999,00	8,00	13,00	104,00
26	8,10	212,00	8,30	9,00	74,70
27	8,50	221,00	7,95	12,00	95,40
28	7,40	233,00	7,65	10,00	76,50
29	7,90	243,00	8,10	12,00	97,20
30	8,30	255,00	8,10	2,00	16,20
31	7,90	257,00	8,10	11,00	89,10
32	8,30	268,00	7,80	1,00	7,80
33	7,30	269,00	7,50	12,00	90,00
34	7,70	281,00	7,80	6,00	46,80
35	7,90	287,00	8,00	15,00	120,00
36	8,10	302,00	7,45	5,00	42,26
37	8,80	307,00	9,20	4,00	36,80
38	8,60	311,00	8,90	5,00	44,50
39	8,20	316,00	8,60	8,00	68,80
40	9,00	324,00	9,00	1,00	9,00

41	9,00	325,00	9,20	11,00	101,20
42	9,40	336,00	9,40	4,00	37,60
43	9,40	340,00	9,60	11,00	105,60
44	8,90	351,00	9,70	3,00	29,10
45	9,60	354,00	9,45	5,00	47,25
46	9,30	359,00	9,45	5,00	47,25
47	9,00	364,00	9,60	9,00	86,40
48	9,60	373,00	9,20	1,00	9,20
49	8,80	374,00	9,40	10,00	94,00
50	10,00	384,00	9,65	13,00	125,45
51	9,30	396,00	9,75	2,00	19,50
52	10,20	399,00	10,10	5,00	50,50
53	10,00	404,00	9,90	13,00	128,70
54	9,80	417,00	9,80	16,00	156,80
55	9,80	433,00	9,60	6,00	57,60
56	9,40	439,00	9,60	6,00	57,60
57	9,80	445,00	9,20	11,00	101,20
58	8,60	456,00	7,40	19,00	140,60
59	6,20	475,00	6,65	3,00	19,95
60	7,10	478,00	7,60	4,00	30,40
61	8,10	482,00	6,44	11,00	70,75
62	4,77	493,00	5,33	7,00	37,34
63	5,90	500,00	2,95	5,00	14,75
64	0,00	505,00			

Reni, Danube cross section, August 7, 1998, 54th Mile

No	The working depth	Distance from the observation site, cm	Depth between verticals, m	Distance between verticals, m	The cross section area between verticals
1	0,00	10,50	3,55	8,00	28,40
2	7,10	18,50	7,80	2,00	15,60
3	8,50	20,50	12,05	10,00	120,50
4	15,60	30,50	16,40	10,00	164,00
5	17,20	40,50	17,30	00,00	00,00
6	17,40	40,50	17,50	17,90	313,25
7	17,60	58,40	16,90	0,80	13,52
8	16,20	59,20	17,00	1,30	22,10
9	17,80	60,50	17,50	11,70	204,75
10	17,20	72,20	17,50	8,30	145,25
11	17,80	80,50	17,60	10,00	176,00
12	17,40	90,50	16,60	4,90	81,34
13	15,80	95,40	15,80	4,40	69052
14	15,80	99,80	15,40	2,20	33,88
15	15,00	102,00	15,30	8,00	122,40
16	15,60	110,00	15,70	26,00	480,20

17	15,80	136,00	15,80	3,00	47,40
18	15,80	139,00	15,60	18,00	280,80
19	15,40	157,00	14,80	10,00	148,00
20	14,20	167,00	14,70	10,00	147,00
21	15,20	177,00	15,30	3,00	45,90
22	15,40	180,00	15,30	12,00	183,60
23	15,20	192,00	15,15	10,00	151,50
24	15,10	202,00	15,15	12,00	181,80
25	15,20	214,00	14,85	12,00	178,20
26	14,50	226,00	14,60	6,00	87,60
27	14,70	232,00	14,20	9,00	127,80
28	13,70	241,00	13,40	23,00	308,20
29	13,10	264,00	12,70	8,00	101,60
30	12,30	272,00	11,80	19,00	224,20
31	11,30	291,00	11,70	6,00	70,20
32	12,10	297,00	12,10	8,00	96,80
33	12,10	305,00	12,10	14,0	168,00
34	11,90	319,00	11,75	13,00	152,75
35	11,60	332,00	11,50	4,00	46,00
36	11,40	336,00	11,00	10,00	110,00
37	10,60	346,00	11,00	6,00	66,00
38	11,40	352,00	11,20	20,00	224,00
39	11,00	372,00	10,80	4,00	43,20
40	10,60	376,00	10,50	10,00	105,00
41	10,40	386,00	10,20	11,00	112,20
42	10,00	397,00	9,80	7,00	68,60
43	9,60	404,00	9,30	16,00	148,80
44	9,00	420,00	8,80	6,00	52,80
45	8,60	426,00	7,60	16,00	121,60
46	6,60	442,00	6,98	1,00	6,95
47	7,30	443,00	6,80	1,00	6,80
48	6,30	444,00	6,10	16,00	97,60
49	5,90	460,00	6,00	3,00	18,00
50	6,10	463,00	6,53	13,00	71,89
51	4,96	476,00	4,38	8,00	35,04
52	3,80	484,00	4,38	1,00	4,38
53	4,96	485,00	4,47	17,00	76,06
54	3,99	502,00	3,41	12,00	40,92
55	2,83	514,00	3,03	3,00	9,08
56	3,22	517,00	2,60	19,00	49,40
57	1,98	536,00	2,21	4,00	8,84
58	2,44	540,00	2,35	1,00	2,35
59	2,25	541,00	3,72	22,00	81,95
60	5,20	563,00	5,65	2,00	11,30
61	6,10	565,00	7,40	12,00	88,80
62	8,70	577,00	8,95	8,00	71,60

63	9,20	585,00	9,60	1,00	9,60
34	10,00	586,00	10,00	23,00	230,00
65	10,00	609,00	10,10	0,00	0,00
66	10,20	609,00	10,50	25,00	262,55
67	10,80	634,00	10,70	4,00	42,80
68	10,60	638,00	10,80	10,00	108,00
69	11,00	648,00	11,20	4,00	44,80
70	11,40	652,00	11,50	19,00	218,50
71	11,60	671,00	11,70	1,00	11,70
72	11,80	672,00	11,53	5,00	56,75
73	10,90	677,00	11,60	14,00	162,40
74	12,30	691,00	12,30	1,00	12,30
75	12,30	692,00	13,50	17,00	229,50
76	14,70	709,00	14,50	4,00	58,00
77	14,30	713,00	13,85	4,00	55,40
78	13,40	717,00	14,05	5,00	70,25
79	14,70	722,00	13,20	13,00	171,60
80	11,70	735,00	13,65	1,00	13,65
81	15,60	736,00	12,90	8,00	103,20
82	10,20	744,00	8,95	6,00	53,70
83	7,70	750,00	4,78	3,00	14,34
84	1,86	753,00		11,00	27,94
85	3,22	764,00	1,66	1,00	1,66
86	0,00	765,00			

Table 6.2. Wetlands of the Ukrainian section of the Danube River basin

Sity	River	OblastE	DistrictE	Area	Perimeter	CenterXD	CenterYD	NordYDM	SouthYD	EastXDM	WestXDM
Chop	Latoritsa	Zakarpatska	Uzgorodskiy	1,92039	7,84264	22,14,23	48,26,16	48,26,49	48,25,42	22,15,15	22,13,30
Bakosh	Charonda	Zakarpatska	Uzgorodskiy	0,36237	3,16312	22,19,22	48,22,29	48,22,50	48,22,8	22,19,31	22,19,12
Karpovlats	Khustitsa	Zakarpatska	Xustskiy	1,18329	7,41331	23,22,21	48,11,56	48,12,30	48,11,27	23,23,55	23,22,8
Nov-Volchinets	Siret	Chernivetska	Glubotskiy	1,28701	6,06422	26,2,33	47,59,17	47,59,38	47,58,58	26,3,30	26,1,35
Torgovitsa	Okno	Ivano-Frankivska	Gorodenkivskiy	0,083211	1,16108	25,24,17	48,35,51	48,35,57	48,35,44	25,24,23	25,24,10
Torgovitsa	Okno	Ivano-Frankivska	Gorodenkivskiy	0,102775	1,18193	25,24,46	48,35,45	48,35,52	48,35,39	25,24,54	25,24,39
Vishnevka	Orelets	Ivano-Frankivska	Snjatynskiy	0,281841	2,86654	25,22,35	48,32,57	48,33,16	48,32,39	25,22,53	25,22,17
Toporovtsy	Okno	Ivano-Frankivska	Gorodenkivskiy	0,083966	1,24163	25,28,17	48,34,48	48,34,55	48,34,41	25,28,25	25,28,8
Toporovtsy	Okno	Ivano-Frankivska	Gorodenkivskiy	0,041700	0,911387	25,28,46	48,34,46	48,34,50	48,34,41	25,28,55	25,28,38
Toporovtsy	Okno	Ivano-Frankivska	Gorodenkivskiy	0,157924	1,61259	25,29,17	48,33,48	48,33,59	48,33,39	25,29,25	25,29,9
Podvusoke	Okno	Ivano-Frankivska	Snjatynskiy	0,087352	1,11452	25,32,24	48,33,49	48,33,56	48,33,43	25,32,30	25,32,18
Podvusoke	Okno	Ivano-Frankivska	Snjatynskiy	0,132638	2,21872	25,32,5	48,34,27	48,34,35	48,34,18	25,32,27	25,31,43
Torgovitsa	Okno	Ivano-Frankivska	Gorodenkivskiy	0,520302	3,7533	25,29,14	48,36,31	48,36,55	48,36,7	25,29,33	25,28,56
Torgovitsa	Okno	Ivano-Frankivska	Gorodenkivskiy	0,132243	1,33285	25,29,49	48,36,0	48,36,8	48,35,53	25,29,58	25,29,39
Glushkov	Okno	Ivano-Frankivska	Gorodenkivskiy	0,133016	1,34759	25,29,29	48,37,2	48,37,8	48,36,55	25,29,40	25,29,18
Torgovitsa	Okno	Ivano-Frankivska	Gorodenkivskiy	0,250824	2,79788	25,28,11	48,36,26	48,36,38	48,36,12	25,28,30	25,27,50
Torgovitsa	Okno	Ivano-Frankivska	Gorodenkivskiy	1,98132	9,33785	25,26,6	48,37,8	48,37,50	48,36,27	25,27,23	25,24,50
Verbovtsy	Okno	Ivano-Frankivska	Gorodenkivskiy	0,23766	2,70727	25,24,54	48,37,13	48,37,27	48,36,59	25,25,18	25,24,29
Verbovtsy	Okno	Ivano-Frankivska	Gorodenkivskiy	0,092047	1,25309	25,23,39	48,37,24	48,37,31	48,37,18	25,23,49	25,23,30
Verbovtsy	Okno	Ivano-Frankivska	Gorodenkivskiy	0,135323	1,73985	25,24,40	48,38,6	48,38,14	48,37,58	25,24,55	25,24,24
Verbovtsy	Okno	Ivano-Frankivska	Gorodenkivskiy	0,354991	3,77585	25,23,33	48,38,14	48,38,32	48,37,57	25,24,21	25,23,9
Verbovtsy	Okno	Ivano-Frankivska	Gorodenkivskiy	0,151029	1,56339	25,23,20	48,38,48	48,38,57	48,38,39	25,23,30	25,23,11
Okno	Okno	Ivano-Frankivska	Gorodenkivskiy	0,077396	1,24743	25,22,37	48,39,3	48,39,8	48,38,58	25,22,49	25,22,25
Podvysoke	Okno	Ivano-Frankivska	Snjatynskiy	0,152902	1,93551	25,33,36	48,35,0	48,35,8	48,34,51	25,33,55	25,33,17
Jasenev-Polny	Okno	Ivano-Frankivska	Gorodenkivskiy	0,125661	1,42518	25,31,38	48,35,58	48,36,6	48,35,50	25,31,48	25,31,29
Nazarenkovo	Okno	Ivano-Frankivska	Gorodenkivskiy	0,385543	3,14686	25,17,31	48,41,7	48,41,28	48,40,45	25,17,39	25,17,22

Karpovilash	Rika	Zakarpatska	Xustskiy	0,223822	3,08387	23,22,46	48,13,29	48,13,43	48,13,17	23,23,25	23,22,35
Mamalyga	Prut	Chernivetska	Novoselitskiy	0,184157	1,66489	26,35,53	48,15,14	48,15,23	48,15,5	26,36,5	26,35,42
Mamalyga	Prut	Chernivetska	Novoselitskiy	0,085149	1,11159	26,36,30	48,15,10	48,15,15	48,15,4	26,36,38	26,36,21
Mamalyga	Prut	Chernivetska	Novoselitskiy	0,100949	1,42456	26,37,32	48,15,34	48,15,40	48,15,28	26,37,42	26,37,21
Zukotin	Chernjava	Ivano-Frankivska	Kolomyjskiy	0,073734	1,20249	25,3,14	48,40,52	48,40,58	48,40,45	25,3,24	25,3,5
Korshev	Chernjava	Ivano-Frankivska	Kolomyjskiy	0,201743	2,84293	25,1,55	48,40,51	48,41,5	48,40,36	25,2,6	25,1,29
Jakovka	Chernjava	Ivano-Frankivska	Kolomyjskiy	0,168658	1,87643	25,8,27	48,39,33	48,39,43	48,39,23	25,8,40	25,8,15
Goncharov	Chernjava	Ivano-Frankivska	Kolomyjskiy	0,215783	2,64869	25,12,1	48,39,15	48,39,26	48,39,3	25,12,27	25,11,35
Jakovka	Chernjava	Ivano-Frankivska	Kolomyjskiy	0,160396	2,16631	25,8,28	48,39,0	48,39,11	48,38,50	25,8,47	25,8,8
Fatovets	Chernjava	Ivano-Frankivska	Kolomyjskiy	0,820514	7,33745	25,8,51	48,37,34	48,38,18	48,36,50	25,8,56	25,7,46
Ostrovets	Chernjava	Ivano-Frankivska	Gorodenkivskiy	0,188691	2,02802	25,15,53	48,38,47	48,38,58	48,38,37	25,16,10	25,15,35
Ostrovets	Chernjava	Ivano-Frankivska	Gorodenkivskiy	0,185396	1,79114	25,17,43	48,39,38	48,39,48	48,39,28	25,17,54	25,17,32
Reni	lake Kagul	Odeska	Renijskiy	4,90268	14,2968	28,19,0	45,26,4	45,27,35	45,24,32	28,19,48	28,18,12
Dolinskoe	Lake Kagul	Odeska	Renijskiy	0,413157	4,07944	28,25,33	45,31,20	45,31,46	45,30,55	28,25,46	28,25,20
Orlovka	Lake Turko	Odeska	Renijskiy	3,4893	11,8354	28,23,1	45,19,37	45,20,19	45,18,55	28,24,0	28,22,2
Orlovka	Chanel Kartal	Odeska	Renijskiy	13,0417	18,2766	28,30,30	45,17,58	45,19,20	45,16,36	28,32,22	28,28,37
Orlovka	Chanel Kartal	Odeska	Renijskiy	0,504436	5,09874	28,32,19	45,17,59	45,18,37	45,17,21	28,32,32	28,32,5
Novoselskoe	lake Gradeshka	Odeska	Renijskiy	0,211926	2,78443	28,31,34	45,20,35	45,20,53	45,20,18	28,31,46	28,31,23
Novoselskoe	Lake Kugurluj	Odeska	Renijskiy	26,8968	59,2955	28,33,7	45,17,40	45,20,31	45,14,57	28,38,39	28,32,56
Novoselskoe	Lake Kugurluj	Odeska	Izmailsky	3,31138	13,1448	28,40,16	45,15,5	45,15,36	45,14,33	28,42,0	28,38,32
Matroskaja	Lake Kugurluj	Odeska	Izmailsky	0,483834	4,06071	28,42,2	45,14,51	45,15,13	45,14,29	28,42,24	28,41,39
Matroskaja	Lake Kugurluj	Odeska	Izmailsky	0,666244	6,70065	28,42,38	45,15,0	45,15,28	45,14,32	28,43,6	28,42,30

Matroskaja	Lake Kugurluj	Odeska	Izmailsky	2,51192	17,8706	28,43,50	45,15,28	45,16,35	45,14,21	28,44,34	28,43,6
Matroskaja	Lake Kugurluj	Odeska	Izmailsky	0,344806	3,80291	28,44,52	45,14,36	45,14,52	45,14,21	28,45,22	28,44,44
Matroskaja	Lake Kugurluj	Odeska	Izmailsky	0,912365	6,50868	28,44,17	45,14,50	45,15,18	45,14,21	28,44,44	28,43,51
Matroskaja	Lake Kugurluj	Odeska	Izmailsky	2,14739	11,909	28,44,59	45,15,24	45,16,9	45,14,39	28,45,58	28,44,33
Matroskaja	Lake Kugurluj	Odeska	Izmailsky	1,17942	12,3211	28,43,47	45,17,23	45,18,3	45,16,43	28,44,31	28,43,3
Matroskaja	Lake Kugurluj	Odeska	Izmailsky	0,518593	5,73964	28,44,34	45,16,49	45,17,17	45,16,21	28,45,5	28,44,13
Matroskaja	Lake Kugurluj	Odeska	Izmailsky	0,863998	7,59002	28,44,58	45,18,19	45,18,40	45,18,0	28,46,5	28,44,43
Matroskaja	Lake Kugurluj	Odeska	Izmailsky	0,067134	1,13667	28,45,19	45,17,55	45,18,2	45,17,49	28,45,25	28,45,13
Matroskaja	Lake Kugurluj	Odeska	Izmailsky	0,046827	0,866855	28,45,35	45,17,55	45,18,1	45,17,49	28,45,40	28,45,30
Matroskaja	Kilijske girlo	Odeska	Izmailsky	0,416551	3,9437	28,46,57	45,18,4	45,18,23	45,17,44	28,47,10	28,46,19
Matroskaja	Kilijske girlo	Odeska	Izmailsky	0,162063	2,37895	28,47,19	45,18,12	45,18,25	45,17,58	28,47,30	28,47,7
Matroskaja	Kilijske girlo	Odeska	Izmailsky	0,225162	3,11614	28,47,44	45,18,7	45,18,28	45,17,46	28,48,1	28,47,27
Matroskaja	Kilijske girlo	Odeska	Izmailsky	0,138513	1,92794	28,45,13	45,18,53	45,19,1	45,18,46	28,45,30	28,44,56
Matroskaja	Kilijske girlo	Odeska	Izmailsky	0,250348	2,15703	28,45,38	45,19,9	45,19,22	45,18,56	28,45,51	28,45,25
Matroskaja	Lake Kugurluj	Odeska	Izmailsky	2,01186	8,18784	28,43,41	45,19,26	45,20,7	45,18,44	28,44,41	28,42,40
Matroskaja	Kilijske girlo	Odeska	Izmailsky	0,140067	1,58352	28,45,5	45,19,18	45,19,27	45,19,9	28,45,15	28,44,55

Matroskaja	Kilijske girlo	Odeska	Izmailsky	1,78796	10,5591	28,44,36	45,19,45	45,20,34	45,18,56	28,45,11	28,44,1
Matroskaja	meadow Ripila	Odeska	Izmailsky	1,66083	10,4352	28,43,47	45,20,14	45,20,44	45,19,43	28,44,49	28,42,44
Novonekrasovka	Lake Kugurluj	Odeska	Izmailsky	0,327147	2,89137	28,42,22	45,20,32	45,20,46	45,20,17	28,42,37	28,42,6
Novonekrasovka	Lake Kugurluj	Odeska	Izmailsky	0,132834	1,47458	28,41,46	45,20,31	45,20,39	45,20,23	28,41,56	28,41,36
Novonekrasovka	Lake Kugurluj	Odeska	Izmailsky	1,22964	10,5327	28,41,19	45,20,47	45,21,7	45,20,26	28,42,44	28,39,54
Novonekrasovka	Lake Jalpug	Odeska	Renijskiy	0,080012	1,0661	28,38,48	45,20,20	45,20,27	45,20,14	28,38,54	28,38,41
Novonekrasovka	Lake Kugurluj	Odeska	Renijskiy	0,094586	1,18276	28,39,25	45,20,19	45,20,26	45,20,12	28,39,32	28,39,18
Staraja Nekrasovka	Lake Safjan	Odeska	Izmailsky	18,2693	21,1892	28,57,41	45,22,8	45,24,20	45,19,55	28,59,11	28,56,10
Staraja Nekrasovka	Ivanesht	Odeska	Izmailsky	6,82471	12,6777	29,0,23	45,20,47	45,21,37	45,19,58	29,2,21	28,58,26
Kislitsa	Island Bolshoj Doller	Odeska	Izmailsky	2,07433	8,05988	29,5,38	45,22,50	45,23,8	45,22,33	29,6,59	29,4,17
Kislitsa	Kilijske girlo	Odeska	Izmailsky	0,441577	4,45083	29,3,26	45,22,13	45,22,38	45,21,49	29,4,9	29,3,7
Leski	island Ermakov	Odeska	Kilijskiy	21,2813	20,9672	29,29,29	45,25,54	45,27,12	45,24,34	29,32,43	29,26,15
Shevchenkovo	liman Grabovsky	Odeska	Kilijskiy	0,340797	3,68844	29,24,57	45,30,21	45,30,36	45,30,6	29,25,30	29,24,38
Shevchenkovo	liman Grabovsky	Odeska	Kilijskiy	0,395569	3,88575	29,25,47	45,30,37	45,30,52	45,30,22	29,26,20	29,25,34
Shevchenkovo	liman Grabovsky	Odeska	Kilijskiy	0,462911	4,63185	29,27,22	45,30,52	45,31,13	45,30,31	29,27,41	29,26,35
Shevchenkovo	liman Grabovsky	Odeska	Kilijskiy	0,254288	3,40297	29,27,47	45,30,55	45,31,9	45,30,40	29,28,9	29,27,38

Mirnoe	liman Grabovsky	Odeska	Kilijskiy	0,13199	1,45952	29,29,17	45,31,56	45,32,4	45,31,47	29,29,25	29,29,8
Desantnoe	lliman Grabovsky	Odeska	Kilijskiy	0,153614	1,89462	29,29,34	45,32,40	45,32,50	45,32,31	29,29,47	29,29,21
Mirnoe	girlo Murza	Odeska	Kilijskiy	0,106514	1,32911	29,28,48	45,31,13	45,31,20	45,31,7	29,28,59	29,28,36
Desantnoe	girlo Murza	Odeska	Kilijskiy	0,869305	7,4126	29,30,10	45,32,9	45,32,46	45,31,31	29,30,41	29,29,38
Primorskoe	Liman Bolshoj Solenyj	Odeska	Kilijskiy	0,249151	2,75791	29,35,2	45,32,48	45,33,4	45,32,31	29,35,6	29,34,45
Primorskoe	Liman Girinskiy	Odeska	Kilijskiy	0,800323	7,25344	29,34,20	45,30,45	45,31,18	45,30,13	29,34,41	29,33,59
Primorskoe	liman Bolshoj Solenyj	Odeska	Kilijskiy	0,365399	3,49015	29,32,25	45,31,45	45,32,0	45,31,29	29,32,49	29,32,1
Desantnoe	girlo Murza	Odeska	Kilijskiy	0,114166	1,31466	29,31,41	45,31,42	45,31,49	45,31,35	29,31,50	29,31,32
Desantnoe	girlo Murza	Odeska	Kilijskiy	0,140473	2,1625	29,29,57	45,30,52	45,31,1	45,30,44	29,30,19	29,29,51
Desantnoe	girlo Murza	Odeska	Kilijskiy	0,435346	4,07682	29,30,33	45,30,44	45,31,5	45,30,22	29,30,59	29,30,7
Desantnoe	girlo Murza	Odeska	Kilijskiy	0,334398	3,86235	29,31,52	45,31,7	45,31,21	45,30,53	29,32,12	29,31,32
Desantnoe	girlo Murza	Odeska	Kilijskiy	0,179724	2,40383	29,31,15	45,30,59	45,31,8	45,30,50	29,31,30	29,31,8
Desantnoe	girlo Murza	Odeska	Kilijskiy	0,265407	1,98889	29,32,31	45,30,51	45,31,1	45,30,41	29,32,44	29,32,18
Primorskoe	girlo Murza	Odeska	Kilijskiy	0,118333	1,89536	29,33,1	45,30,40	45,30,54	45,30,26	29,33,8	29,32,55
Desantnoe	girlo Murza	Odeska	Kilijskiy	0,412985	2,98832	29,30,44	45,30,7	45,30,24	45,29,51	29,31,5	29,30,23
Desantnoe	girlo Murza	Odeska	Kilijskiy	0,152729	1,50997	29,31,17	45,31,33	45,31,41	45,31,24	29,31,26	29,31,7
Primorskoe	girlo Lantush	Odeska	Kilijskiy	0,393958	3,39111	29,31,54	45,30,24	45,30,32	45,30,16	29,32,29	29,31,19
Primorskoe	girlo Lantush	Odeska	Kilijskiy	2,82272	9,47472	29,32,18	45,29,50	45,30,32	45,29,9	29,33,23	29,31,13
Mirnoe	girlo Lantush	Odeska	Kilijskiy	2,86506	11,8775	29,28,54	45,29,57	45,30,21	45,29,34	29,30,44	29,27,5
Primorskoe	liman Gebrinskiy	Odeska	Kilijskiy	3,74694	16,0162	29,36,20	45,29,43	45,31,1	45,28,24	29,36,44	29,34,43

Primorskoe	liman Gebrinskiy	Odeska	Kilijskiy	0,255427	2,74841	29,34,53	45,30,4	45,30,18	45,29,51	29,35,10	29,34,35
Primorskoe	liman Pogarny	Odeska	Kilijskiy	0,210398	3,14537	29,37,15	45,30,14	45,30,36	45,29,52	29,37,24	29,37,7
Primorskoe	liman Gebrinsky	Odeska	Kilijskiy	11,1539	15,7996	29,33,52	45,29,2	45,30,32	45,27,26	29,35,22	29,32,23
Primorskoe	liman Gebrinsky	Odeska	Kilijskiy	0,473502	5,5505	29,35,0	45,27,58	45,28,33	45,27,23	29,35,25	29,34,17
Vilkovo	island Limon	Odeska	Kilijskiy	18,2873	22,2897	29,41,48	45,14,16	45,16,2	45,12,31	29,43,51	29,39,45
Vilkovo	Island Kubansky	Odeska	Kilijskiy	71,0599	38,8971	29,42,34	45,17,20	45,21,1	45,13,39	29,45,44	29,39,24
Vilkovo	Island Prorvin	Odeska	Kilijskiy	9,86395	21,9608	29,43,53	45,28,1	45,29,20	45,26,42	29,47,15	29,42,55
Vilkovo	Danuba delta	Odeska	Kilijskiy	56,6749	53,6928	29,39,50	45,26,45	45,29,37	45,23,52	29,44,58	29,34,42
Vilkovo	Danuba delta	Odeska	Kilijskiy	109,403	54,4578	29,42,3	45,23,51	45,27,23	45,20,18	29,47,58	29,36,10

Table 6.3.'Water quality parameters, Danube, data of hydrometeorological observation network

Parameters	Months	Vilkovo (1 km downstream)			Izmail (1 km downstream)			Reni (1 km downstream)			Vilkovo	Izmail	Reni
		1994	1995	1996	1994	1995	1996	1994	1995	1996	average annual		
Total mineral nitrog	Jan	0.45	2.37	1.2	0.132	2.26	0.96	0.152	1.7	0.98			
(mg/l)	Feb	0.26	2.33	2.8	0.15	2.2	2.8	0.15	1.9	2.5			
	Mar	1.26	2.3	2.2	0.36	2.2	2	0.4	2.18	2.1			
	Apr	1.5	2.2	1.8	0.42	2.5	1.55	0.34	2.6	1.2			
	May	1.3	2.4	1.9	0.42	2	1.72	0.41	2.29	1.8			
	Jun	0.51	1.9	2	1.35	2	1.8	1.41	1.97	1.9			
	Jul	0.32	1.8	2.1	*	2.1	2.5	*	1.82	2.1			
	Aug	*	1.9	1.5	*	1.9	2	*	1.6	1.3			
	Sep	*	1.6	1.8	*	1.5	1.7	*	1.5	1.1			
	Oct	0.92	1.6	*	1.75	1.6	*	1.6	0.92	*			
	Nov	1.48	1.77	*	0.8	1	*	1.65	0.58	*			
	Dec	*	1.3	*	1.24	1.7	*	1.23	1.26	*			
Average per year		0.89	1.96	1.92	0.74	1.91	1.89	0.82	1.69	1.66	1.59	1.51	1.39
Max		1.50	2.40	2.80	1.75	2.50	2.80	1.65	2.60	2.50	2.80	2.80	2.60
Min		0.26	1.30	1.20	0.13	1.00	0.96	0.15	0.58	0.98	0.26	0.13	0.15
Total phosphorus	Jan	0.18	0.58	0.5	0.216	0.3	0.39	0.27	0.31	0.22			
(mg/l)	Feb	0.2	0.41	0.18	0.12	0.3	0.18	0.16	0.19	0.22			
	Mar	0.264	0.13	0.1	0.24	0.13	0.07	0.19	0.11	0.06			
	Apr	0.38	0.14	0.1	0.39	0.18	0.08	0.36	0.2	0.1			
	May	1	0.24	0.9	0.77	0.12	0.13	0.62	0.21	0.12			
	Jun	0.41	0.16	0.13	0.52	0.17	0.15	0.41	0.2	0.15			
	Jul	*	0.1	0.21	*	0.15	0.15	*	0.15	0.16			
	Aug	*	0.085	0.18	*	0.14	0.18	*	0.1	0.15			
	Sep	*	0.065	0.12	*	0.1	0.08	*	0.1	0.12			
	Oct	0.46	0.13	*	0.51	0.13	*	0.46	0.08	*			
	Nov	0.53	0.13	*	0.52	0.14	*	0.48	0.12	*			
	Dec	*	0.12	*	0.91	0.09	*	0.58	0.11	*			
Average per year		0.43	0.19	0.27	0.47	0.16	0.16	0.39	0.16	0.14	0.30	0.26	0.23
Max		1.00	0.58	0.90	0.91	0.30	0.39	0.62	0.31	0.22	1.00	0.91	0.62
Min		0.18	0.07	0.10	0.12	0.09	0.07	0.16	0.08	0.06	0.07	0.07	0.06
Oil products	Jan	0.06	0.15	*	0.11	0.05	0.08	0.05	0.06	0.07			
(mg/l)	Feb	0.13	0.16	0.07	0.1	0.05	0.07	0.11	0.1	0.07			
	Mar	0.05	0.13	0.015	0.09	0.08	*	0.09	0.1	0.07			
	Apr	0.08	0.15	0.05	0	0.2	0.06	0.12	0.2	0.1			
	May	0.2	0.33	0.1	0.15	*	0.06	0.13	0.3	0.06			
	Jun	0.19	0.25	0.09	0.14	0.2	0.04	0.16	0.2	0.05			
	Jul	*	0.12	0.09	*	0.08	0.05	*	0.1	0.07			
	Aug	*	0.12	*	*	0.07	0.05	*	0.05	0.05			
	Sep	*	0.08	0.05	*	0.07	0.04	*	0.08	0.05			
	Oct	0.05	0.11	*	0.08	0.07	*	0.07	0.05	*			
	Nov	0.06	0.11	*	0.055	0.17	*	0.08	0.12	*			

	Dec	*	0.24	*	0.07	0.13	*	0.11	0.09	*			
Average per year		0.11	0.16	0.07	0.09	0.11	0.06	0.10	0.12	0.07	0.11	0.08	0.10
Max		0.20	0.33	0.10	0.15	0.20	0.08	0.16	0.30	0.10	0.33	0.20	0.30
Min		0.05	0.08	0.02	0.00	0.05	0.04	0.05	0.05	0.05	0.02	0.00	0.05
BOD5	Jan	2.7	2	2.9	2.53	0.6	2.8	3.08	1.2	3.04			
(mg/l)	Feb	0.5	2	3	0.8	2.5	2.3	0.13	2.6	3.1			
	Mar	1.9	2	2.7	2.05	3.4	3	1.85	2.5	3.1			
	Apr	0.64	2.3	3.4	0.25	2.1	4	0.65	2.8	3.3			
	May	4.5	2.5	2.5	4.51	2.3	2.5	4.05	2.7	2.4			
	Jun	2.6	1.9	2.2	1.25	1.5	3.2	1.11	2	1.9			
	Jul	*	1.8	4.1	*	3.1	4.6	*	3.1	4			
	Aug	*	4.2	4.6	*	2.4	4.3	*	3.3	4.3			
	Sep	*	4.6	1.7	*	3.8	1.8	*	4.3	1.9			
	Oct	1.9	4.5	*	3.41	4.8	*	2.6	4.9	*			
	Nov	1.5	2.7	*	1.71	3	*	1.35	2.8	*			
	Dec	*	3.4	*	1.71	3.1	*	1.89	3.3	*			
Average per year		2.03	2.83	3.01	2.02	2.72	3.17	1.86	2.96	3.00	2.62	2.64	2.61
Max		4.50	4.60	4.60	4.51	4.80	4.60	4.05	4.90	4.30	4.60	4.80	4.90
Min		0.50	1.80	1.70	0.25	0.60	1.80	0.13	1.20	1.90	0.50	0.25	0.13
Zn (2+)	Jan	190	49	70	*	*	*	95	33	45			
(ppm)	Feb	38	82	75	*	*	*	115	56	24			
	Mar	38.5	60	38	*	*	*	44	81	26			
	Apr	168	86	18	*	*	*	185	46	60			
	May	209	80	43	*	*	*	92	100	8			
	Jun	106	126	*	*	*	*	185	210	*			
	Jul	122	345	*	*	*	*	70	50	*			
	Aug	78	62	*	*	*	*	76	35	*			
	Sep	153	30	10	*	*	*	128	34	20			
	Oct	70	35	*	*	*	*	75	25	*			
	Nov	75	85	*	*	*	*	92	16	*			
	Dec	130	30	*	*	*	*	80	27	*			
Average per year		114.79	89.17	42.33				103.08	59.42	30.50	82.10		64.33
Max		209.00	345.00	75.00				185.00	210.00	60.00	345.00		210.00
Min		38.00	30.00	10.00				44.00	16.00	8.00	10.00		8.00
Cr (6+)	Jan	5	0.8	6	*	*	*	1	0.3	4.1			
	Feb	3.6	0	*	*	*	*	0.7	*	*			
	Mar	0	0	*	*	0.7	*	0	1.2	*			
	Apr	0.7	0	*	0.7	*	*	1.4	*	*			
	May	1.4	0	*	*	*	*	1.4	*	*			
	Jun	1.1	0	*	*	*	*	1.7	1.4	1.5			
	Jul	*	10	*	*	10	*	*	2.5	3.8			
	Aug	*	6	*	*	*	*	*	1.1	3.8			
	Sep	1	2	*	*	3.9	3	*	4.6	0.4			

	Oct	*	1.9	*	*	1.8	*	0.7	*	*			
	Nov	*	8	*	*	*	*	0	*	*			
	Dec	*	8	*	*	7.4	*	0	7	*			
Average per year		1.83	3.06	6.00	0.70	4.76	3.00	0.77	2.59	2.72	3.63	2.82	2.02
Max		5.00	10.00	6.00	0.70	10.00	3.00	1.70	7.00	4.10	10.00	10.00	7.00
Min		0.00	0.00	6.00	0.70	0.70	3.00	0.00	0.30	0.40	0.00	0.70	0.00
Cu (2+)	Jan	5.1	3	2.8	*	*	*	3.5	4	2.8			
	Feb	2	4.2	4.8	*	*	*	3.4	5.4	1.8			
	Mar	2.2	4.7	2.4	*	*	*	3.4	6	0.8			
	Apr	1.2	10.5	3.8	*	*	*	3.8	2.1	1.6			
	May	4.6	2.4	3.1	*	*	*	4.1	2.2	4.4			
	Jun	3.1	1.6	4	*	*	*	3.4	1.4	*			
	Jul	5.2	2	*	*	*	*	5.9	6.5	*			
	Aug	3.1	2	*	*	*	*	3.3	1.6	*			
	Sep	2	2	*	*	*	*	0.8	2.4	*			
	Oct	3.4	2	*	*	*	*	2.4	5.4	*			
	Nov	4	3.9	*	*	*	*	6.7	2.6	*			
	Dec	9	2.6	*	*	*	*	2.4	3.5	*			
Average per year		3.74	3.41	3.48				3.59	3.59	2.28	3.54		3.15
Max		9.00	10.50	4.80				6.70	6.50	4.40	10.50		6.70
Min		1.20	1.60	2.40				0.80	1.40	0.80	1.20		0.80
Water flow	Jan	5220	2410	5250	5530	2510	5170	9740	4370	10700			
m^3/s	Feb	3500	4100	3000	4090	4310	3130	8820	7680	7410			
	Mar	3450	1890	2800	3620	4520	2990	6150	8400	5510			
	Apr	3890	2000	6700	5630	4530	7530	10300	9420	13000			
	May	4800	1420	5630	5030	5190	6150	9320	9200	11000			
	Jun	3500	4920	4800	3650	7500	4980	6650	9620	8590			
	Jul	*	3490	2890	*	3490	3010	*	6330	5000			
	Aug	*	2610	2300	*	2630	2410	*	4610	4170			
	Sep	*	3860	4060	*	3710	4330	*	5360	7990			
	Oct	2000	2600	*	2150	2710	*	3630	4890	*			
	Nov	2220	2080	*	2360	2160	*	3620	3660	*			
	Dec	*	2080	*	2200	3190	*	3700	6270	*			
Average per year		3572.50	2788.33	4158.89	3806.67	3870.83	4411.11	6881.11	6650.83	8152.22	3506.57	4029.54	7228.06
Max		5220.00	4920.00	6700.00	5630.00	7500.00	7530.00	10300.00	9620.00	13000.00	6700.00	7530.00	13000.00
Min		2000.00	1420.00	2300.00	2150.00	2160.00	2410.00	3620.00	3660.00	4170.00	1420.00	2150.00	3620.00

Table 6.4. 'Water quality parameters, Tissa, data of hydrometeorological observation network

Parameters	Months	Khust (4 km upstream)			Rakhiv (0.5 km downstream)			Tyachiv (9 km upstream)			Vilok (in village)			Khust	Rakhiv	Tiachiv	Vilok
		1994	1995	1996	1994	1995	1996	1994	1995	1996	1994	1995	1996	average annual			
Total mineral (mg/l)	Jan	3.7	1.6	0.36	*	*	*	2.9	*	0.57	*	*	0.84				
	Feb	*	*	*	*	*	5.2	3.2	2.1	*	*	2.1	*				
	Mar	*	*	*	*	0.44	*	2.4	*	*	3.41	*	*				
	Apr	2.8	3.9	6	*	*	*	2.9	1.5	4.3	2.84	2.1	3.7				
	May	*	*	*	*	*	*	2	*	*	*	1.1	*				
	Jun	2.6	*	*	*	*	*	3	*	*	*	*	*				
	Jul	*	3.5	*	*	*	*	5.4	*	*	1.71	*	*				
	Aug	*	*	*	4.2	*	*	*	*	*	0.85	1.4	*				
	Sep	*	*	*	*	0.74	*	4.5	1.3	*	*	1.2	*				
	Oct	3.2	1.2	*	*	*	*	2.3	*	*	0.1	*	*				
	Nov	*	*	*	*	*	*	1.6	*	*	0.96	2.7	*				
	Dec	*	*	*	2.2	1.2	*	0.8	*	*	2.49	*	*				
Average per year		3.08	2.55	3.18	3.20	0.79	5.20	2.82	1.63	2.44	1.77	1.77	2.27	2.94	3.06	2.30	1.93
Max		3.70	3.90	6.00	4.20	1.20	5.20	5.40	2.10	4.30	3.41	2.70	3.70	6.00	5.20	5.40	3.70
Min		2.60	1.20	0.36	2.20	0.44	5.20	0.80	1.30	0.57	0.10	1.10	0.84	0.36	0.44	0.57	0.10
Total phosph (mg/l)	Jan	0.01	0.22	0.07	*	*	*	0.09	*	0.07	*	*	0.12				
	Feb	*	*	*	*	*	0.0075	*	0.09	*	*	0.09	*				
	Mar	*	*	*	*	0.08	*	0.01	*	*	0.02	*	*				
	Apr	0.03	0.2	0.11	*	*	*	*	0.05	0.15	0.02	0.07	0.14				
	May	*	*	*	*	*	*	0.04	*	*	*	0.15	*				
	Jun	0.08	*	*	*	*	*	0.14	*	*	*	*	*				
	Jul	*	0.2	*	*	*	*	*	*	*	0.12	*	*				
	Aug	*	*	*	0.09	*	*	*	*	*	0.19	0.05	*				
	Sep	*	*	*	*	0.08	*	*	0.01	*	*	0.14	*				
	Oct	0.1	0.2	*	*	*	*	0.13	*	*	0.04	*	*				
	Nov	*	*	*	*	*	*	*	*	*	0.12	0.12	*				
	Dec	*	*	*	0.51	0.08	*	0.02	*	*	0.15	*	*				
Average per year		0.06	0.21	0.09	0.30	0.08	0.01	0.07	0.05	0.11	0.09	0.10	0.13	0.12	0.13	0.08	0.11
Max		0.10	0.22	0.11	0.51	0.08	0.01	0.14	0.09	0.15	0.19	0.15	0.14	0.22	0.51	0.15	0.19
Min		0.01	0.20	0.07	0.09	0.08	0.01	0.01	0.01	0.07	0.02	0.05	0.12	0.01	0.01	0.01	0.02
Oil products (mg/l)	Jan	0.12	0.06	0	*	*	*	0.04	*	0.04	*	*	*				
	Feb	*	*	*	*	*	0.05	0.1	0.12	*	*	0.1	*				
	Mar	*	*	*	*	0.16	*	0.04	*	*	0.16	*	*				
	Apr	0.32	0.06	0.11	*	*	*	0.04	0.06	0.13	0.14	0.1	0.11				
	May	*	*	*	*	*	*	0.04	*	*	*	0.19	*				
	Jun	0.14	*	*	*	*	*	0.08	*	*	*	*	*				
	Jul	*	0	*	*	*	*	0.06	*	*	0.08	*	*				
	Aug	*	*	*	0.14	*	*	*	*	*	0.21	0.02	*				
	Sep	*	*	*	*	0.25	*	0.14	0.2	*	*	0.13	*				
	Oct	0.14	*	*	*	*	*	0.4	*	*	0.14	*	*				
	Nov	*	*	*	*	*	*	0.17	*	*	*	0.06	*				

	Dec	*	0.11	*	0.14	0.11	*	0.04	*	*	0.08	*	*				
Average per year		0.18	0.06	0.06	0.14	0.17	0.05	0.10	0.13	0.09	0.14	0.10	0.11	0.10	0.12	0.11	0.12
Max		0.32	0.11	0.11	0.14	0.25	0.05	0.40	0.20	0.13	0.21	0.19	0.11	0.32	0.25	0.40	0.21
Min		0.12	0.00	0.00	0.14	0.11	0.05	0.04	0.06	0.04	0.08	0.02	0.11	0.00	0.05	0.04	0.02
BOD5 (mg/l)	Jan	3.2	2.2	2	*	*	*	2.5	*	2.4	*	*	2				
	Feb	*	*	*	*	*	4.2	4.5	2.1	*	*	2.5	*				
	Mar	*	*	*	*	2.9	*	2.6	*	*	3.1	*	*				
	Apr	2.7	2	2.7	*	*	*	3	2.3	2	2.1	2.5	2				
	May	*	*	*	*	*	*	2	*	*	*	2.4	*				
	Jun	2	*	*	*	*	*	2	*	*	*	*	*				
	Jul	*	2	*	*	*	*	2.46	*	*	2.9	*	*				
	Aug	*	*	*	2.1	*	*	*	*	*	2.1	2.8	*				
	Sep	*	*	*	*	2.9	*	3.2	2.5	*	*	2.3	*				
	Oct	2.1	2.4	*	*	*	*	2.2	*	*	2	*	*				
	Nov	*	*	*	*	*	*	2.4	*	*	2	2.2	*				
	Dec	*	*	*	2.1	5.3	*	2.1	*	*	2.2	*	*				
Average per year		2.50	2.15	2.35	2.10	3.70	4.20	2.63	2.30	2.20	2.34	2.45	2.00	2.33	3.33	2.38	2.26
Max		3.20	2.40	2.70	2.10	5.30	4.20	4.50	2.50	2.40	3.10	2.80	2.00	3.20	5.30	4.50	3.10
Min		2.00	2.00	2.00	2.10	2.90	4.20	2.00	2.10	2.00	2.00	2.20	2.00	2.00	2.10	2.00	2.00
Zn (2+) (ppm)	Jan	*	*	*	*	*	*	*	*	*	*	*	*				
	Feb	*	*	*	*	*	*	*	*	*	*	*	*				
	Mar	*	*	*	*	*	*	*	*	*	*	*	*				
	Apr	*	*	*	*	*	*	*	*	*	*	*	*				
	May	*	*	*	*	*	*	*	*	*	*	*	*				
	Jun	*	*	*	*	*	*	*	*	*	*	*	*				
	Jul	*	*	*	*	*	*	*	*	*	*	*	*				
	Aug	*	*	*	65	*	*	*	*	*	*	*	*				
	Sep	*	*	*	*	*	*	*	*	*	*	*	*				
	Oct	*	*	*	*	*	*	*	*	*	*	*	*				
	Nov	*	*	*	*	*	*	*	*	*	*	*	*				
	Dec	*	*	*	132	*	*	*	*	*	*	*	*				
Average per year					98.50										98.50		
Max					132.00										132.00		
Min					65.00										65.00		
Cr (6+)	Jan	3.3	12	5.4	*	*	*	3.3	*	4.2	*	*	20				
	Feb	*	*	*	*	*	2.1	3.7	12	*	*	11	*				
	Mar	*	*	*	*	12	*	6.4	*	*	6.2	*	*				
	Apr	20.8	4.2	6.2	*	*	*	5.8	12	4.2	4.1	2.5	10				
	May	*	*	*	*	*	*	12.5	*	*	*	17	*				
	Jun	14.6	*	*	*	*	*	15.4	*	*	*	*	*				
	Jul	*	14	*	*	*	*	10.4	*	*	6.3	*	*				
	Aug	*	*	*	6.2	*	*	*	*	*	6.2	15	*				
	Sep	*	*	*	*	10	*	10.4	8.3	*	*	2.1	*				

	Oct	4.1	*	*	*	*	*	5	*	*	14.6	*	*				
	Nov	*	*	*	*	*	*	12.5	*	*	13.7	39	*				
	Dec	*	*	*	5	10	*	10.4	*	*	26.8	*	*				
Average per year		10.70	10.07	5.80	5.60	10.67	2.10	8.71	10.77	4.20	11.13	14.43	15.00	8.86	6.12	7.89	13.52
Max		20.80	14.00	6.20	6.20	12.00	2.10	15.40	12.00	4.20	26.80	39.00	20.00	20.80	12.00	15.40	39.00
Min		3.30	4.20	5.40	5.00	10.00	2.10	3.30	8.30	4.20	4.10	2.10	10.00	3.30	2.10	3.30	2.10
Cu (2+)	Jan	*	*	*	*	*	*	*	*	*	*	*	*				
	Feb	*	*	*	*	*	*	*	*	*	*	*	*				
	Mar	*	*	*	*	*	*	*	*	*	*	*	*				
	Apr	*	*	*	*	*	*	*	*	*	*	*	*				
	May	*	*	*	*	*	*	*	*	*	*	*	*				
	Jun	*	*	*	*	*	*	*	*	*	*	*	*				
	Jul	*	*	*	*	*	*	*	*	*	*	*	*				
	Aug	*	*	*	5.2	*	*	*	*	*	*	*	*				
	Sep	*	*	*	*	*	*	*	*	*	*	*	*				
	Oct	*	*	*	*	*	*	*	*	*	*	*	*				
	Nov	*	*	*	*	*	*	*	*	*	*	*	*				
	Dec	*	*	*	5.6	*	*	*	*	*	*	*	*				
Average per year					5.40										5.40		
Max		0.00	0.00	0.00	5.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.60	0.00	0.00
Min		0.00	0.00	0.00	5.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water flow	Jan	210	151	90	*	*	*	160	*	75.7	*	*	107				
m^3/s	Feb	*	*	*	*	*	9.3	118	280	*	*	262	*				
	Mar	*	*	*	*	38.4	*	239	*	*	*	*	*				
	Apr	336	247	110	*	*	*	299	205	92.7	3.8	362	131				
	May	*	*	*	*	*	*	466	*	*	*	176	*				
	Jun	338	*	*	*	*	*	222	*	*	*	*	*				
	Jul	*	230	*	*	*	*	47.9	*	*	21	*	*				
	Aug	*	*	*	8.7	*	*	*	*	*	49.4	36.7	*				
	Sep	*	*	*	*	14.9	*	40	106	*	*	71.7	*				
	Oct	188	95	*	*	*	*	161	*	*	22.5	*	*				
	Nov	*	*	*	*	*	*	60	*	*	61.2	37.7	*				
	Dec	*	*	*	9.8	11.6	*	60	*	*	65	*	*				
Average per year		266.00	180.75	100.00	9.25	21.63	9.30	170.26	197.00	84.20	37.15	157.68	119.00	182.92	13.39	150.49	104.61
Max		338.00	247.00	110.00	9.80	38.40	9.30	466.00	280.00	92.70	65.00	362.00	131.00	338.00	38.40	466.00	362.00
Min		188.00	95.00	90.00	8.70	11.60	9.30	40.00	106.00	75.70	3.80	36.70	107.00	90.00	8.70	40.00	3.80

Table 6-5.Water quality parameters, Uzh, data of hydrometeorological observation network

Parameters	Months	Uzhgorod (2 km downstream)			Uzhgorod
		1994	1995	1996	average annual
Total mine (mg/l)	Jan	3.8	*	0.92	
	Feb	4.2	1.89	3.9	
	Mar	3.2	2.3	4	
	Apr	2.6	2.3	*	
	May	1.5	1.6	3.7	
	Jun	3.4	1.2	*	
	Jul	*	*	*	
	Aug	*	1.16	*	
	Sep	3.6	*	*	
	Oct	2.3	1.7	*	
	Nov	1.6	1.58	*	
	Dec	1.5	1.5	*	
Average per year		2.77	1.69	3.13	2.53
Max		4.20	2.30	4.00	3.13
Min		1.50	1.16	0.92	1.69
Total phos (mg/l)	Jan	*	*	0.08	
	Feb	0.02	0.1	*	
	Mar	*	0.04	0.09	
	Apr	0.03	*	*	
	May	*	0.005	*	
	Jun	*	0.015	*	
	Jul	*	*	*	
	Aug	*	0.13	*	
	Sep	*	*	*	
	Oct	*	0.11	*	
	Nov	0.2	*	*	
	Dec	*	0.03	*	
Average per year		0.08	0.06	0.09	0.08
Max		0.20	0.13	0.09	0.09
Min		0.02	0.01	0.08	0.06
Oil product (mg/l)	Jan	0	0	0.04	
	Feb	0	0.12	0.06	
	Mar	0.23	*	0.36	
	Apr	0.04	0.1	*	
	May	0.16	0.02	*	
	Jun	0.32	0.08	0.05	
	Jul	*	0	*	
	Aug	*	0.11	*	
	Sep	0.17	*	*	
	Oct	0.4	0	*	
	Nov	0.04	0.11	*	

	Dec	0.06	0.08	*				
Average per year		0.14	0.06	0.13	0.11			
Max		0.40	0.12	0.36	0.14			
Min		0.00	0.00	0.04	0.06			
BOD5 (mg/l)	Jan	3.1	0	2.8				
	Feb	5.7	2.3	2.4				
	Mar	2.9	2.7	2.1				
	Apr	2	2.3	*				
	May	2	2.6	*				
	Jun	2	2.4	2.88				
	Jul	*	*	*				
	Aug	*	2.5	*				
	Sep	2.4	*	*				
	Oct	2	2.8	*				
	Nov	2.3	2	*				
	Dec	2	2.5	*				
Average per year		2.64	2.21	2.55	2.47			
Max		5.70	2.80	2.88	2.64			
Min		2.00	0.00	2.10	2.21			
Zn (2+) (ppm)	Jan	*	*	*				
	Feb	*	*	*				
	Mar	*	*	*				
	Apr	*	*	*				
	May	*	*	*				
	Jun	*	*	*				
	Jul	*	*	*				
	Aug	*	*	*				
	Sep	*	*	*				
	Oct	*	*	*				
	Nov	*	*	*				
	Dec	*	*	*				
Average per year								
Max								
Min								
Cr (6+)	Jan	3.3	*	23				
	Feb	1.6	23	18				
	Mar	3.7	8.3	9.2				
	Apr	6.2	4.6	*				
	May	8.3	8.3	*				
	Jun	18.7	6.3	6.2				
	Jul	*	*	*				
	Aug	*	8.3	*				
	Sep	11.3	*	*				

	Oct	10.4	4.2	*				
	Nov	75.8	6.2	*				
	Dec	10.4	15	*				
Average per year		14.97	9.36	14.10	12.81			
Max		75.80	23.00	23.00	14.97			
Min		1.60	4.20	6.20	9.36			
Cu (2+)	Jan	*	*	*				
	Feb	*	*	*				
	Mar	*	*	*				
	Apr	*	*	*				
	May	*	*	*				
	Jun	*	*	*				
	Jul	*	*	*				
	Aug	*	*	*				
	Sep	*	*	*				
	Oct	*	*	*				
	Nov	*	*	*				
	Dec	*	*	*				
Average per year								
Max								
Min								
Water flow m^3/s	Jan	42	*	13.5				
	Feb	21.1	38.1	4.66				
	Mar	42.2	21.1	35.9				
	Apr	28	80.7	*				
	May	14.5	44.7	*				
	Jun	25.7	14.5	8.6				
	Jul	*	*	*				
	Aug	*	3.7	*				
	Sep	11	*	*				
	Oct	5.6	5.1	*				
	Nov	21.1	12	*				
	Dec	23	12.5	*				
Average per year		23.42	25.82	15.67	21.64			
Max		42.20	80.70	35.90	25.82			
Min		5.60	3.70	4.66	15.67			

Table 6-6. 'Water quality parameters, Prut, data of hydrometeorological observation network

Parameters	Months	Chernivtsi (3 km downstream)			Kolomiya (0.5 km downstream)			Chernivtsi	Kolomyia
		1994	1995	1996	1994	1995	1996	average annual	
Total mine (mg/l)	Jan	3.7	2.37	2	*	*	*		
	Feb	4.7	2.12	4.2	*	*	1.84		
	Mar	2.5	2.7	*	*	*	*		
	Apr	1.4	1.4	5.9	*	2.48	*		
	May	2.9	0.37	*	1.94	1.84	*		
	Jun	2.6	1.3	*	*	*	*		
	Jul	2.8	1.9	2.4	*	*	*		
	Aug	3.1	2	*	2.6	*	*		
	Sep	3.7	1.2	*	*	*	2.46		
	Oct	1.1	1.1	*	4	*	*		
	Nov	1.8	1.3	*	*	*	*		
	Dec	1.2	2	*	*	*	*		
Average per year		2.63	1.65	3.63	2.85	2.16	2.15	2.63	2.39
Max		4.70	2.70	5.90	4.00	2.48	2.46	5.90	4.00
Min		1.10	0.37	2.00	1.94	1.84	1.84	0.37	1.84
Total phos (mg/l)	Jan	0.03	0.12	0.17	*	*	*		
	Feb	*	*	*	*	*	0.11		
	Mar	*	0.06	*	*	*	*		
	Apr	*	*	0.07	*	0.11	*		
	May	0.05	0.13	*	0.08	0.51	*		
	Jun	0.05	0.16	*	*	*	*		
	Jul	1	*	0.07	*	*	*		
	Aug	*	*	*	0.05	*	0.21		
	Sep	0.06	*	*	*	*	*		
	Oct	*	0.14	*	0.03	*	*		
	Nov	0.14	0.15	*	*	*	*		
	Dec	0.04	0.15	*	*	*	*		
Average per year		0.20	0.13	0.10	0.05	0.31	0.16	0.14	0.17
Max		1.00	0.16	0.17	0.08	0.51	0.21	1.00	0.51
Min		0.03	0.06	0.07	0.03	0.11	0.11	0.03	0.03
Oil product (mg/l)	Jan	0.04	0	0.1	*	*	*		
	Feb	0.04	0	0.04	*	*	0.04		
	Mar	0.1	0.04	*	*	*	*		
	Apr	0.1	0.84	0.04	*	0.04	*		
	May	0.19	0.36	*	0.08	0.23	*		
	Jun	0.1	0.13	*	*	*	*		
	Jul	0.1	0.11	0.14	*	*	*		
	Aug	0.14	1.16	*	0.26	*	*		
	Sep	0.14	0.06	*	*	0.25	0.23		
	Oct	0.51	0.19	*	0.12	*	*		
	Nov	0.12	0.02	*	*	*	*		

	Dec	0.21	0.02	*	*	0.11	*		
Average per year		0.15	0.24	0.08	0.15	0.16	0.14	0.16	0.15
Max		0.51	1.16	0.14	0.26	0.25	0.23	1.16	0.26
Min		0.04	0.00	0.04	0.08	0.04	0.04	0.00	0.04
BOD5	Jan	3.4	3	2.5	*	*	*		
(mg/l)	Feb	2	3.79	3.3	*	*	2.9		
	Mar	3.4	4.2	*	*	*	*		
	Apr	2	2.1	2.9	*	2.9	*		
	May	2	2.9	*	2.03	3.11	*		
	Jun	2	2.4	*	*	*	*		
	Jul	2.06	2.2	3.7	*	*	*		
	Aug	2.2	2.5	*	3.1	*	*		
	Sep	2.1	3.5	*	*	2.9	3.1		
	Oct	3.8	4.1	*	3	*	*		
	Nov	2.6	2.7	*	*	*	*		
	Dec	4.2	2.7	*	*	5.3	*		
Average per year		2.65	3.01	3.10	2.71	3.55	3.00	2.92	3.09
Max		4.20	4.20	3.70	3.10	5.30	3.10	4.20	5.30
Min		2.00	2.10	2.50	2.03	2.90	2.90	2.00	2.03
Zn (2+)	Jan	18	41	53	*	*	*		
(ppm)	Feb	10	45	27	*	*	0		
	Mar	13	50	*	*	*	*		
	Apr	52	45	23	*	0	*		
	May	49	5	*	0	2.5	*		
	Jun	13	2.5	*	*	*	*		
	Jul	46	40	85	*	*	*		
	Aug	36	62	*	15	*	*		
	Sep	13	30	*	*	*	*		
	Oct	13	80	*	21	*	0.002		
	Nov	15	92	*	*	*	*		
	Dec	41	92	*	*	*	*		
Average per year		26.58	48.71	47.00	12.00	1.25	0.00	40.76	4.42
Max		52.00	92.00	85.00	21.00	2.50	0.00	92.00	21.00
Min		10.00	2.50	23.00	0.00	0.00	0.00	2.50	0.00
Cr (6+)	Jan	6.5	16	7.1	*	*	*		
	Feb	3.7	15	6.2	*	*	0.003		
	Mar	10	40	*	*	*	*		
	Apr	15	10	0	*	3.3	*		
	May	12.5	48	*	25	6.2	*		
	Jun	10.4	33	*	*	*	*		
	Jul	8.3	14	16	*	*	*		
	Aug	15	17	*	17.5	*	0.006		
	Sep	10.4	2.2	*	*	*	*		

	Oct	10.4	0	*	17.5	*	*			
	Nov	8.3	2.3	*	*	*	*			
	Dec	6.2	1.7	*	*	*	*			
Average per year		9.73	16.60	7.33	20.00	4.75	0.00	11.22	8.25	
Max		15.00	48.00	16.00	25.00	6.20	0.01	48.00	25.00	
Min		3.70	0.00	0.00	17.50	3.30	0.00	0.00	0.00	
Cu (2+)	Jan	0.6	3	12	*	*	*			
	Feb	0	12	18	*	*	*			
	Mar	0	13	*	*	*	4			
	Apr	39	13	13	*	4	*			
	May	41	9	*	0	21	*			
	Jun	26	26	*	*	*	*			
	Jul	0	16	35	*	*	*			
	Aug	10	3	*	0	*	21			
	Sep	0	0	*	*	*	*			
	Oct	13	2	*	*	*	*			
	Nov	5	28	*	*	*	*			
	Dec	2	38	*	*	*	*			
Average per year		11.38	13.58	19.50	0.00	12.50	12.50	14.82	8.33	
Max		41.00	38.00	35.00	0.00	21.00	21.00	41.00	21.00	
Min		0.00	0.00	12.00	0.00	4.00	4.00	0.00	0.00	
Water flow	Jan	35	26.1	17.6	*	*	*			
m^3/s	Feb	22	42.4	16.7	*	*	*			
	Mar	127	187	*	*	*	*			
	Apr	62	121	19.3	*	15.7	*			
	May	64.5	137	*	22	26	*			
	Jun	76.5	80	*	*	*	*			
	Jul	25.2	32	70	*	*	*			
	Aug	76.2	48.2	*	4.76	*	*			
	Sep	23	32	*	*	*	*			
	Oct	21.6	*	*	3.5	*	*			
	Nov	24.6	45.2	*	*	*	*			
	Dec	*	27.8	*	*	*	*			
Average per year		50.69	70.79	30.90	10.09	20.85		50.79	15.47	
Max		127.00	187.00	70.00	22.00	26.00	0.00	187.00	26.00	
Min		21.60	26.10	16.70	3.50	15.70	0.00	16.70	0.00	

Annex 6-7 "Index of Water Quality and Discharge Records"

Sampling Station Name & ID #	River Name	River Bank (L, R or M)	Coordinates or Disttance to mouth (km)	Number of Years of Records and the Latest Year of Record for Each of the Following Categories of Parameters						
				Water Discharge	Sediment Discharge	N (mineral. forms)	P	BOD or COD	Heavy Metals	Other Toxics
Reni	Danube	M	163	26(64)/98	26(64)/98	61/98	61/98	61/98	61/98	61/98
Reni	Danube	M	136	21/98	21/98	NR	NR	NR	NR	NR
Ismail	Danube, Kiliyske ç	M	115	59/98	59/98	NR	NR	NR	NR	NR
Ismail	Danube, Kiliyske ç	M	94	28/98	28/98	65/98	65/98	65/98	65/98	65/98
w.Kislitsa	Danube, Kiliyske ç	M	68	21/98	21/98	NR	NR	NR	NR	NR
Kiliya	Danube, Kiliyske ç	M	47	45/98	45/98	71/98	71/98	71/98	71/98	71/98
Vilkovo	Danube, Kiliyske ç	M	26	NR	NR	72/98	72/98	72/98	72/98	72/98
Rakhov	Tissa	M	962	21/98	21/98	49/98	49/98	49/98	49/98	49/98
Velikiy Bichkov	Tissa	M	926	29(49)/98	29(49)/98	NR	NR	NR	NR	NR
Tiyachev	Tissa	M	887	26(45)/98	26(45)/98	63/98	63/98	63/98	63/98	63/98
Khust	Tissa	M	854	21(42)/98	21(42)/98	65/98	65/98	65/98	65/98	65/98
w.Wilok	Tissa	M	808	46(66)/98	46(66)/98	61/98	61/98	61/98	61/98	61/98
Chop	Tissa	M	695	1888/98	1888/98	74/98	74/98	74/98	74/98	74/98
Yasinia	Chorna Tissa	M	27	1860(1950)/98	1860(1950)/98	63/98	63/98	63/98	63/98	63/98
w.Lugi	Billa Tissa	M	15	21(47)/98	21(47)/98	63/98	63/98	63/98	63/98	63/98
Velikiy Bichkov	Shopurka	M	3	NR	NR	88/98	88/98	88/98	88/98	88/98
w.Kosivska Po	Kosivska	M	8	46/98	46/98	NR	NR	NR	NR	NR
Ust' Chorna	Teresva	M	54	62/98	62/98	NR	NR	NR	NR	NR
w.Neresnitsa	Teresva	M	18	45/98	45/98	NR	NR	NR	NR	NR
w.Russka Mok	Mokryanka	M	2.4	48/98	48/98	NR	NR	NR	NR	NR
Kolochava	Tereblya	M	58	27/98	27/98	57/98	57/98	57/98	57/98	57/98
w.Verhniy Bist	Rika	M	77	51/98	51/98	NR	NR	NR	NR	NR
Mizhgirya	Rika	M	64	46(65)/98	46(65)/98	58/98	58/98	58/98	58/98	58/98
Khust	Rika	M	1	45/98	45/98	NR	NR	NR	NR	NR
Maydan	Hgolyatinka	M	2.5	1898(1955)/98	1898(1955)/98	93/98	93/98	93/98	93/98	93/98
w.Repino	Repinka	M	3.9	55/98	55/98	58/98	58/98	58/98	58/98	58/98
w.Pilipets	Pilipets	M	1	45(56)/98	45(56)/98	NR	NR	NR	NR	NR
w.Nizhniy Stuc	Studeniy	M	4.5	56/98	56/98	NR	NR	NR	NR	NR
w.Dovge	Borjava	M	69	46/98	46/98	NR	NR	NR	NR	NR
w.Shalanky	Borjava	M	32	25(46)/98	25(46)/98	NR	NR	NR	NR	NR
w.Podpoloshiy	Latoritsa	M	167	25(46)/98	25(46)/98	63/98	63/98	63/98	63/98	63/98
Svalyava	Latoritsa	M	138	28(46)/98	28(46)/98	78/98	78/98	78/98	78/98	78/98
Mukachevo	Latoritsa	M	106	27(61)/98	27(61)/98	53/98	53/98	53/98	53/98	53/98
Chop	Latoritsa	M	56	1880(1948)/98	1880(1948)/98	75/98	75/98	75/98	75/98	75/98
w.Nelepino	Wicha	M	1.5	1878(1956)/98	1878(1956)/98	63/98	63/98	63/98	63/98	63/98
w.Znyatsevo	Stara	M	12	57/98	57/98	NR	NR	NR	NR	NR
Perechin	Uzh	M	54.5	NR	NR	78/98	78/98	78/98	78/98	78/98
w.Zhornava	Uzh	M	100	28(46)/98	28(46)/98	NR	NR	NR	NR	NR
w.Zarechevo	Uzh	M	60	27(46)/98	27(46)/98	NR	NR	NR	NR	NR

Uzhgorod	Uzh	M	33	46/98	46/98	53/98	53/98	53/98	53/98	53/98
w.Simmer	Turiya	M	1.4	1889(1948)/98	1889(1948)/98	NR	NR	NR	NR	NR
Storozhinets	Siret	M	448	57/98	57/98	61/98	61/98	61/98	61/98	61/98
Vorokhta	Prut	M	955	1886(1962)/98	1886(1962)/98	NR	NR	NR	NR	NR
Krementsi	Prut	M	932	77/98	77/98	NR	NR	NR	NR	NR
Yaremcha	Prut	M	914	1887/98	1887/98	61/98	61/98	61/98	61/98	61/98
Kolomiya	Prut	M	867	1872/98	1872/98	83/98	83/98	83/98	83/98	83/98
Chernivtsi	Prut	M	772	1880(1944)/98	1880(1944)/98	46/98	46/98	46/98	46/98	46/98
w.Dora	Kamiyanka	M	0.8	45/98	45/98	66/98	66/98	66/98	66/98	66/98
w.Lubkovtsi	Chernyava	M	4.5	84/98	84/98	NR	NR	NR	NR	NR
w.Usteriki	Cheremosh	M	79	1890(1957)/98	1890(1957)/98	NR	NR	NR	NR	NR
Kuti	Cheremosh	M	47	1897(1927)/98	1897(1927)/98	53/98	53/98	53/98	53/98	53/98
w.Yablonitsa	Billiy Cheremosh	M	14	54/98	54/98	NR	NR	NR	NR	NR
Verkhovina	Cherniy Cheremos	M	19	10(63)/98	10(63)/98	63/98	63/98	63/98	63/98	63/98
w.Iltsi	Iltsya	M	4.2	30(50)/98	30(50)/98	NR	NR	NR	NR	NR
Putila	Putila	M	19	50(63)/98	50(63)/98	NR	NR	NR	NR	NR

(*) in brackets the term of moving of water measuring post in other place

Table 6.8. Routine Biological Monitoring of the Rivers of the Ukrainian Section of the Danube River Basin (1990-1995)

Ukraine, Danube

variable	frequency	actual range	description of methodology
Phytoplankton biomass	4	0,33- 7,041	filtration, conservation, count
Zooplankton biomass	4	0-0,6104	filtration, conservation, count
Fecal coliforms	12	280-24000	
Coliforms	12	500-7000000	
Total bacterial number	12	170-8100	

variable	frequency	description of methodology
Phytoplankton	4	filtration, conservation, count
Total species abundance	4	filtration, conservation, count
Total species number	4	filtration, conservation, count
Abundance of dominant species groups	4	filtration, conservation, count
Number of species in species group	4	filtration, conservation, count
Dominant and saprobic indicator species	4	filtration, conservation, count
mass and indicator species (name, % total number; saprobic index)	4	filtration, conservation, count
Zooplankton	4	filtration, conservation, count
total species abundance	4	filtration, conservation, count
total species number	4	filtration, conservation, count
abundance of dominant species groups	4	filtration, conservation, count
number of species in species group	4	filtration, conservation, count
dominant and saprobic indicator species	4	filtration, conservation, count
mass and indicator species (name, % total number; saprobic index)	4	filtration, conservation, count
Zoobenthos	4	filtration, conservation, count
total species abundance	4	filtration, conservation, count
total species number	4	filtration, conservation, count
abundance of dominant species groups	4	filtration, conservation, count
number of species in species group	4	filtration, conservation, count
dominant and saprobic indicator species	4	filtration, conservation, count
mass and indicator species (name, % total number; saprobic index)	4	filtration, conservation, count

Ukraine, Borjava

variable	frequency	actual range	description of methodology
Saprophytic bacteria (22^{o}C)	12		
Saprophytic bacteria (37^{o}C)	12		
Fecal coliforms	12		
Coliforms	12		
Coli-phagues	12		
Enterococci	12		
Pathogens	12		

- data are available on the request from the regional sanitary and epidemiological center; not at the border crossing

Ukraine, Bug

variable	frequency	actual range	description of methodology
Phytoplankton biomass	3	0,0500-70,660	filtration, conservation, count
Zooplankton biomass	3	0,0001-0,1255	filtration, conservation, count
Fecal coliforms	12		
Coliforms	12		
Saprophytic bacteria (22^{o}C)	12		
Saprophytic bacteria (37^{o}C)	12		
Coli-phagues	12		
Enterococci	12		
Pathogens	12		

- data are available on the request from the regional sanitary and epidemiological center; not at the border crossing

variable	frequency	description of methodology
phytoplankton:		filtration, conservation, count
abundance;	4	filtration, conservation, count
total species number;	4	filtration, conservation, count
dominant species groups number;	4	filtration, conservation, count
species number in groups;	4	filtration, conservation, count
biomass of dominant species groups;	4	filtration, conservation, count
mass and indicator species (name, %	4	filtration, conservation, count
total number; saprobic index)	4	
zooplankton:	4	filtration, conservation, count
abundance;	4	filtration, conservation, count
total species number;	4	filtration, conservation, count
dominant species groups number;	4	filtration, conservation, count
species number in groups;	4	filtration, conservation, count
biomass of dominant species groups;	4	filtration, conservation, count
mass and indicator species (name, %	4	filtration, conservation, count
total number; saprobic index)		
zoobenthos	4	filtration, conservation, count
abundance;	4	filtration, conservation, count
total species number;	4	filtration, conservation, count
dominant species groups number;	4	filtration, conservation, count
species number in groups;	4	filtration, conservation, count
biomass of dominant species groups;	4	filtration, conservation, count
mass and indicator species (name, %	4	filtration, conservation, count
total number; saprobic index)		

Ukraine, Desna

variable	frequency	actual range	description of methodology
Phytoplankton biomass	4	1,856-4,317	filtration, conservation, count
Zooplankton biomass	4	0,0089-0,7995	filtration, conservation, count
Saprophytic bacteria (22^{o}C)	12		
Saprophytic bacteria (37^{o}C)	12		
Fecal coliforms	12		
Coliforms	12		
Coli-phagues	12		
Enterococci	12		
Pathogens	12		

- data are available on the request from the regional sanitary and epidemiological center; not at the border crossing

variable	frequency	description of methodology
Phytoplankton:	4	filtration, conservation, count
abundance;	4	filtration, conservation, count
total species number;	4	filtration, conservation, count
dominant species groups number;	4	filtration, conservation, count
species number in groups;	4	filtration, conservation, count
biomass of dominant species groups;	4	filtration, conservation, count
mass and indicator species (name, % total number; saprobic index)	4	filtration, conservation, count
Zooplankton:	4	filtration, conservation, count
abundance;	4	filtration, conservation, count
total species number;	4	filtration, conservation, count
dominant species groups number;	4	filtration, conservation, count
species number in groups;	4	filtration, conservation, count
biomass of dominant species groups;	4	filtration, conservation, count
mass and indicator species (name, % total number; saprobic index)	4	filtration, conservation, count
Zoobenthos	4	filtration, conservation, count
abundance;	4	filtration, conservation, count
total species number;	4	filtration, conservation, count
dominant species groups number;	4	filtration, conservation, count
species number in groups;	4	filtration, conservation, count
biomass of dominant species groups;	4	filtration, conservation, count
mass and indicator species (name, % total number; saprobic index)	4	filtration, conservation, count

Ukraine, Latorytsa

variable	frequency	actual range	description of methodology
Phytoplankton biomass	4	0,037-1,154	filtration, conservation, count
Zooplankton biomass	4	0,0001-0,0047	filtration, conservation, count
Fecal coliforms	12		
Saprophytic bacteria (22^{o}C)	12		
Saprophytic bacteria (37^{o}C)	12		
Coliforms	12		
Coliforms	12		
Enteroococci	12		
Pathogenes	12		

- bacteriological data are provided on the request by regional sanitary and epidemiological center; not at the border crossing

variable	frequency	description of methodology
Phytoplankton:	4	filtration, conservation, count
abundance;	4	filtration, conservation, count
total species number;	4	filtration, conservation, count
dominant species groups number;	4	filtration, conservation, count
species number in groups;	4	filtration, conservation, count
biomass of dominant species groups;	4	filtration, conservation, count
mass and indicator species (name, % total number; saprobic index)	4	filtration, conservation, count
Zooplankton:	4	filtration, conservation, count
abundance;	4	filtration, conservation, count
total species number;	4	filtration, conservation, count
dominant species groups number;	4	filtration, conservation, count
species number in groups;	4	filtration, conservation, count
biomass of dominant species groups;	4	filtration, conservation, count
mass and indicator species (name, % total number; saprobic index)	4	filtration, conservation, count
Zoobenthos	4	filtration, conservation, count
abundance;	4	filtration, conservation, count
total species number;	4	filtration, conservation, count
dominant species groups number;	4	filtration, conservation, count
species number in groups;	4	filtration, conservation, count
biomass of dominant species groups;	4	filtration, conservation, count
mass and indicator species (name, % total number; saprobic index)		

Ukraine, Prut

variable	frequency	actual range	description of methodology
Phytoplankton biomass	4	0,527-3,302	filtration, conservation, count
Zooplankton biomass	4	0,0002-0,0496	filtration, conservation, count
Saprophytic bacteria (22°C)	12		
Saprophytic bacteria (37°C)	12		
Coliforms	12		
Coli-phagues	12		
Enteroococci	12		
Pathogens	12		

-data are available on request from the regional sanitary and epidemiological center; not at the border crossing

variable	frequency	description of methodology
<u>Phytoplankton:</u>	4	filtration, conservation, count
abundance;	4	filtration, conservation, count
total species number;	4	filtration, conservation, count
dominant species groups number;	4	filtration, conservation, count
species number in groups;	4	filtration, conservation, count
biomass of dominant species groups;	4	filtration, conservation, count
mass and indicator species (name, %	4	filtration, conservation, count
total number; saprobic index)		
<u>Zooplankton:</u>	4	filtration, conservation, count
abundance;	4	filtration, conservation, count
total species number;	4	filtration, conservation, count
dominant species groups number;	4	filtration, conservation, count
species number in groups;	4	filtration, conservation, count
biomass of dominant species groups;	4	filtration, conservation, count
mass and indicator species (name, %	4	filtration, conservation, count
total number; saprobic index)		
<u>Zoobenthos</u>	4	filtration, conservation, count
abundance;	4	filtration, conservation, count
total species number;	4	filtration, conservation, count
dominant species groups number;	4	filtration, conservation, count
species number in groups;	4	filtration, conservation, count
biomass of dominant species groups;	4	filtration, conservation, count
mass and indicator species (name, %	4	filtration, conservation, count
total number; saprobic index)	4	filtration, conservation, count

Ukraine, Siret

variable	frequency	actual range	description of methodology
Fecal coliforms	12		
Saprophytic bacteria (22^{o}C)	12		
Saprophytic bacteria (37^{o}C)	12		
Coliforms	12		
Coliforms	12		
Index streprtococci	12		
Pathogens	12		

- Only microbiological data are available on the request from the regional sanitary and epidemiological center; not at the border crossing

Ukraine, Tisza

variable	frequency	actual range	description of methodology
Phytolpankton biomass	4	0,13-0,427	
Zooplankton biomass	4	0,0006-0,057	
Saprophytic bacteria (22°C)			
Saprophytic bacteria (37°C)			
Coliforms			
Coli-phagues			
Index streprtococci			
Pathogens			

- bacteriological data are provided on the request by regional sanitary and epidemiological center; nor at the border crossing

variable	frequency	description of methodology
Phytoplankton:	4	filtration, conservation, count
abundance;	4	filtration, conservation, count
total species number;	4	filtration, conservation, count
dominant species groups number;	4	filtration, conservation, count
species number in groups;	4	filtration, conservation, count
biomass of dominant species groups;	4	filtration, conservation, count
mass and indicator species (name, %	4	filtration, conservation, count
total number; saprobic index)		
Zooplankton:	4	filtration, conservation, count
abundance;	4	filtration, conservation, count
total species number;	4	filtration, conservation, count
dominant species groups number;	4	filtration, conservation, count
species number in groups;	4	filtration, conservation, count
biomass of dominant species groups;	4	filtration, conservation, count
mass and indicator species (name, %	4	filtration, conservation, count
total number; saprobic index)	4	
Zoobenthos		filtration, conservation, count
abundance;	4	filtration, conservation, count
total species number;	4	filtration, conservation, count
dominant species groups number;	4	filtration, conservation, count
species number in groups;	4	filtration, conservation, count
biomass of dominant species groups;	4	filtration, conservation, count
mass and indicator species (name, %	4	filtration, conservation, count
total number; saprobic index)	4	

Ukraine, Ubort

variable	frequency	actual range	description of methodology
Fecal coliforms	12		
Saprophytic bacteria (22^{o}C)	12		
Saprophytic bacteria (37^{o}C)	12		
Coliforms	12		
Coli-phagues	12		
Enterococci	12		
Pathogenes	12		

bacteriological data are provided on the request by regional sanitary and epidemiological center; not at the border crossing

Ukraine, Uzh

variable	frequency	actual range	description of methodology
Phytoplankton biomass	4	0,004-3,568	filtration, conservation, count
Zooplankton biomass	4	0,0001-0,0044	filtration, conservation, count
Saprophytic bacteria (22^{o}C)	12		
Saprophytic bacteria (37^{o}C)	12		
Coliforms	12		
Coli-phagues	12		
Enterococci	12		
Pathogens	12		

bacteriological data are provided on the request by regional sanitary and epidemiological center; nor at the border crossing

variable	frequency	description of methodology
Phytoplankton:	4	filtration, conservation, count
abundance;	4	filtration, conservation, count
total species number;	4	filtration, conservation, count
dominant species groups number;	4	filtration, conservation, count
species number in groups;	4	filtration, conservation, count
biomass of dominant species groups;	4	filtration, conservation, count
mass and indicator species (name, % total number; saprobic index)	4	filtration, conservation, count
Zooplankton:	4	filtration, conservation, count
abundance;	4	filtration, conservation, count
total species number;	4	filtration, conservation, count
dominant species groups number;	4	filtration, conservation, count
species number in groups;	4	filtration, conservation, count
biomass of dominant species groups;	4	filtration, conservation, count
mass and indicator species (name, % total number; saprobic index)	4	filtration, conservation, count
Zoobenthos	4	filtration, conservation, count
abundance;	4	filtration, conservation, count
total species number;	4	filtration, conservation, count
dominant species groups number;	4	filtration, conservation, count
species number in groups;	4	filtration, conservation, count
biomass of dominant species groups;	4	filtration, conservation, count
mass and indicator species (name, % total number; saprobic index)	4	filtration, conservation, count

Table 6.9. Chemical Monitoring of Rivers of the Ukrainian Section of the Danube River Basin (1990-1995)

Ukraine, Danube

variable	y/n	medium	actual range	analytical method	detection limits
color number	y	w	10-30	Pt-Co scale	1,0
SECCI	y	w	>1,5	ISO 7027	
PH	y	w	7,3-7,8	ISO 10523	
flow	y	w	0,5-1,7	hydrometric	0,01
TEMP	y	w	0-22	thermometer	0,1
SS	y	w	10-120	gravimetric	0,1

variable	y/n	medium	Actual range	analytical method	detection limits
O2	y	w	5,2-10,5	ISO 5813	
BOD-5	y	w	2,5-8,3	ISO 5815	
COD-Cr	y	w	10-49	ISO 6060	
NH4 - N	y	w	0,15-0,54	ISO 5664	
NO2 - N	y	w	0,01-0,06	PHotometric	0,005
NO3 - N	y	w	1,0-17,0	ISO 7890-3	
O - PO4 - P - DIS	y	w	0,2-0,4	ISO 6878	
P - TOT	y	w	0,3-0,5	PHotometric	0,02
CL	y	w	35-60	ISO 9297	
SO4	y	w	50-130	ISO 9280	
SI - DIS	y	w	0,8-4,0	PHotometric	0,5
CA - DIS	y	w	40-60	ISO 6058	
Cu - DIS	y	w	0,007-0,03	ISO 8288	
FE- DIS	y	w	0,02-1,00	ISO 8288	
Mn - DIS	y	w	0,035-0,20	ISO 8288	
Zn - DIS	y	w	0,10-0,40	ISO 8288	
SYNDETS	y	w	0,03-0,13		
A - HCH	y	w, sus	dl-0,000005	ISO 7875-1	
B - HCH	y	w, sus	d,l,	GC	0,0000005
C-HCH	y	w, sus	d,l-0,00001	GC	
DDT - SUM	y	w, sus	d,l,	GC	0,0000005
OIL	y	w	0,12-0,66	GC	0,000002
PHENOL-SUM	y	w	0,001-0,008	ISO 9377	
Hardness	y	w	3,5-4,3	ISO 6439	
Chromium 6+	y	w	d,l,-0,003	ISO 6059	
COD - Mn	y	w	1,4-8,3	ISO 11088	

Ukraine, Borjava

variable	y/n	medium	actual range	analytical method	detection limits
color number	y	w	18-26	Pt-Co scale	1,0
PH	y	w	6,4-7,6	ISO 10523	
flow	y	w	0,4-0,5	hydrometric	0,01
TEMP	y	w	0-18	thermometer	0,1
SS	y	w	18,5-75	gravimetric	0,1

Variable	frc	medium	actual range	analytical method	detection limits
O2	4	w	9,4-11,7	ISO 5813	
BOD-5	4	w	2,5-4,1	ISO 5815	
COD-Cr	4	w	7-15,3	ISO 6060	
NH4 - N	4	w	0,50-1,40	ISO 5664	
NO2 - N	4	w	0,01-0,02	PHotometric	0,005
NO3 - N	4	w	2,0-3,1	ISO 7890-3	
O - PO4 - P - DIS	4	w	0,02-0,17	ISO 6878	
P - TOT	4	w	0,03-0,23	PHotometric	0,02
CL	4	w	9,2-43	ISO 9297	
SO4	4	w	16-96	ISO 9280	
SI - DIS	4	w	1,0-3,6	PHotometric	0,5
CA - DIS	4	w	22-47	ISO 6058	
Cu - DIS	4	w	0,003-0,029	PHotometric	0,002
FE- DIS	4	w	0,5-3,0	PHotometric	0,02
Zn - DIS	4	w	0,026-0,037	PHotometric	0,002
SYNDETS	4	w	0,04-0,30	ISO 7875-1	
OIL	4	w	0,05-0,51	ISO 9377	
PHENOL-SUM	4	w	0,001-0,008	ISO 6439	
Hardness	4	w	1,5-3,0	ISO 6059	
Chromium 6+	4	w	0,004-,03	ISO 11088	

Ukraine, Latorytsya

variable	y/n	medium	actual range	analytical method	detection limits
color number	6	w	18-22	Pt-Co scale	1,0
PH	6	w	7,4-7,8	ISO 10523	
flow	6	w	0,3-0,5	hydrometric	0,01
TEMP	6	w	0-24	thermometer	0,1
suspended solid	6	w	39-100	gravimetric	0,1

variable	y/n	me dium	actual range	analytical method	detection limits
O2	6	w	7,8-1,4	ISO 5813	
BOD-5	6	w	2,2-3,7	ISO 5815	
COD-Cr	6	w	15-31	ISO 6060	
NH4 - N	6	w	0,93-1,35	ISO 5664	
NO2 - N	6	w	0,01-0,06	PHotometric	0,005
NO3 - N	6	w	0,9-4,2	ISO 7890-3	
O - PO4 - P - DIS	6	w	0,03-0,98	ISO 6878	
P - TOT	6	w	0,03-0,08	PHotometric	0,02
CL	6	w	17-45	ISO 9297	
SO4	6	w	45-154	ISO 9280	
SI - DIS	6	w	0,9-3,2	PHotometric	0,5
CA - DIS	6	w	27-40	ISO 6058	
SYNDETS	6	w	0,01-0,11	ISO 7875-1	
A - HCH	6	w, sus	d,l,-0,000003	GC	0,0000005
B - HCH	6	w, sus	d,l,	GC	
C-HCH	6	w, sus	d,l,-0,000001	GC	0,0000005
DDT - SUM	6	w, sus	d,l,-000001	GC	0,000002
OIL	6	w	0,05-0,52	ISO 9377	
PHENOL-SUM	6	w	d,l,-0,006	ISO 6439	
Hardness	6	w	2,1-2,8	ISO 6059	
Chromium 6+	6	w	0,001-0,011	ISO 11088	

Ukraine, Prut

variable	y/n	medium	actual range	analytical method	detection limits
color number	12	w	18-22	Pt-Co scale	1,0
PH	12	w	7,2-7,6	ISO 10523	
flow	12	w	0,2-1,4	hydrometric	0,01
TEMP	12	w	0-20	thermometer	0,1
SS	12	w	7,4-75	gravimetric	0,1

Variable	y/n	medium	actual range	analytical method	detection limits
O2	12	w	7,4-10,8	ISO 5813	
BOD-5	12	w	3,0-8,9	ISO 5815	
COD-Cr	12	w	14-28	ISO 6060	
NH4 - N	12	w	0,55-3,20	ISO 5664	
NO2 - N	12	w	0,01-0,12	PHotometric	0,005
NO3 - N	12	w	0,7-5,1	ISO 7890-3	
O - PO4 - P - DIS	12	w	0,02-0,24	ISO 6878	
P - TOT	12	w	0,03-0,2	PHotometric	0,02
CL	12	w	34-226	ISO 9297	
SO4	12	w	40-234	ISO 9280	
SI - DIS	12	w	0,5-3,2	PHotometric	0,5
CA - DIS	12	w	43-64	ISO 6058	
Cu - DIS	12	w	0,009-0,26	PHotometric	0,002
FE- DIS	12	w	0,1-1,5	PHotometric	0,02
SYNDETS	12	w	0,01-0,13	ISO 7875-1	
A - HCH	12	w,ss	d,l,-0,000005	GC	0,0000005
B - HCH	12	w,ss	d,l	GC	
C-HCH	12	w,ss	d,l,-0,000010	GC	0,0000005
DDT - SUM	12	w,ss	d,l,-0,000007	GC	0,000002
OIL	12	w	0,02-0,30	ISO 9377	
PHENOL-SUM	12	w	d,l,-0,012	ISO 6439	
Hardness	12	w	2,9-4,6	ISO 6059	
Chromium 6+	12	w	d,l,-0,035	ISO 11088	

Ukraine, Siret

variable	y/n	medium	actual range	analytical method	detection limits
color number	y	w	16-20	Pt-Co scale	1,0
PH	y	w	6,0-7,3	ISO 10523	
flow	y	w	0,2-0,7	hydrometric	0,01
TEMP	y	w	0-19	thermometer	0,1
SS	y	w	11-66	gravimetric	0,1

Variable	y/n	medium	actual range	analytical method	detection limits
O2	y	w	6,8-11,2	ISO 5813	
BOD-5	y	w	2,6-5,6	ISO 5815	
COD-Cr	y	w	11-47	ISO 6060	
NH4 - N	y	w	0,40-11,2	ISO 5664	
NO2 - N	y	w	0,01-0,05	PHotometric	0,005
NO3 - N	y	w	0,1-3,65	ISO 7890-3	
O - PO4 - P - DIS	y	w	0,02-0,50	ISO 6878	
P - TOT	y	w	0,03-0,60	PHotometric	0,02
CL	y	w	10-37	ISO 9297	
SO4	y	w	14-83	ISO 9280	
SI - DIS	y	w	0,5-3,2	PHotometric	0,5
CA - DIS	y	w	38-56	ISO 6058	
Cu - DIS	y	w	d,l,-0,042	PHotometric	0,002
FE- DIS	y	w	0,05-0,46	PHotometric	0,02
Zn - DIS	y	w	d,l,-0,045	PHotometric	0,002
SYNDETS	y	w	0,01-0,19	ISO 7875-1	
A - HCH	y	w, sus	d,l,-0,000007	GC	0,000005
B - HCH	y	w, sus	d,l,	GC	
C-HCH	y	w, sus	d,l,-0,000005	GC	0,000005
DDT - SUM	y	w, sus	d,l,	GC	0,00002
OIL	y	w	d,l,-0,21	ISO 9377	
Hardness	y	w	d,l,-0,012	ISO 6439	
Chromium 6+	y	w	2,6-4,3	ISO 6059	
	y	w	d,l,-0,017	ISO 11088	

Ukraine, Tisza

variable	y/n	medium	actual range	analytical method	detection limits
color number	6	w	20-22	Pt-Co scale	1,0
PH	6	w	7,4-7,6	ISO 10523	
flow	6	w	0,5-1,1	hydrometric	0,01
TEMP	6	w	0-24	thermometer	0,1
SS	6	w	21-74	gravimetric	0,1

Variable	y/n	medium	actual range	analytical method	detection limits
O2		w	6,8-17,1	ISO 5813	
BOD-5		w	1,1-6,5	ISO 5815	
COD-Cr		w	21-24	ISO 6060	
NH4 - N		w	0,42-3,10	ISO 5664	
Nitrite nitgogen		w	0,01-0,16	PHotometric	0,005
NO3 - N		w	0,47-3,1	ISO 7890-3	
O - PO4 - P - DIS		w	0,02-0,68	ISO 6878	
P - TOT		w	0,03-0,80	PHotometric	0,02
CL		w	31-58	ISO 9297	
SO4		w	43-133	ISO 9280	
SI - DIS		w	1,0-3,0	PHotometric	0,5
CA - DIS		w	29-48	ISO 6058	
Cu - DIS		w	d,l,-0,025	PHotometric	
FE- DIS		w	0,68-1,50	PHotometric	0,002
Zn - DIS		w	d,l,-0,07	PHotometric	0,002
SYNDETS		w	0,02-0,30	ISO 7875-1	
A - HCH		w, sus	d,l,-0,000002	GC	0,0000005
B - HCH		w, sus	d,l,	GC	
C-HCH		w, sus	d,l,-0,000001	GC	0,0000005
DDT - SUM		w, sus	d,l,	GC	0,000002
OIL		w	0,05-1,35	ISO 9377	
PHENOL-SUM		w	d,l,--0,010	ISO 6439	
Hardness		w	2,1-3,2	ISO 6059	
Chromium 6+		w	0,002-0,02	ISO 11088	

Ukraine, Ubort

variable	y/n	medium	actual range	analytical method	detection limits
color number	7	w	20-36	Pt-Co scale	1,0
PH	7	w	6,4-6,9	ISO 10523	
flow	7	w	0,7-1,0	hydrometric	0,01
TEMP	7	w	0-28	thermometer	0,1
SS	7	w	1,8-15,2	gravimetric	0,1

Variable	y/n	me dium	actual range	analytical method	detection limits
O2	7	w	9,0-13,5	ISO 5813	
BOD-5	7	w	0,86-1,9	ISO 5815	
COD-Cr	7	w	41-94	ISO 6060	
NH4 - N	7	w	1,7-4,4	ISO 5664	
NO2 - N	7	w	0,02-0,06	PHotometric	0,005
NO3 - N	7	w	0,04-0,82	ISO 7890-3	
O - PO4 - P - DIS	7	w	0,12-0,26	ISO 6878	
P - TOT	7	w	0,20-0,50	PHotometric	0,02
CL	7	w	17-74	ISO 9297	
SO4	7	w	22-91	ISO 9280	
SI - DIS	7	w	3,3-4,2	PHotometric	0,5
CA - DIS	7	w	32-51	ISO 6058	
Cu - DIS	7	w	0,004-0,024	PHotometric	0,002
FE- DIS	7	w	0,21-0,89	PHotometric	0,02
Zn - DIS	7	w	0,01-0,30	PHotometric	0,002
SYNDETS	7	w	0,02-0,13	ISO 7875-1	
OIL	7	w	d,l,-0,17	ISO 9377	
Hardness	7	w	1,7-2,6	ISO 6059	
Chromium 6+	7	w	0,013-0,05	ISO 11088	

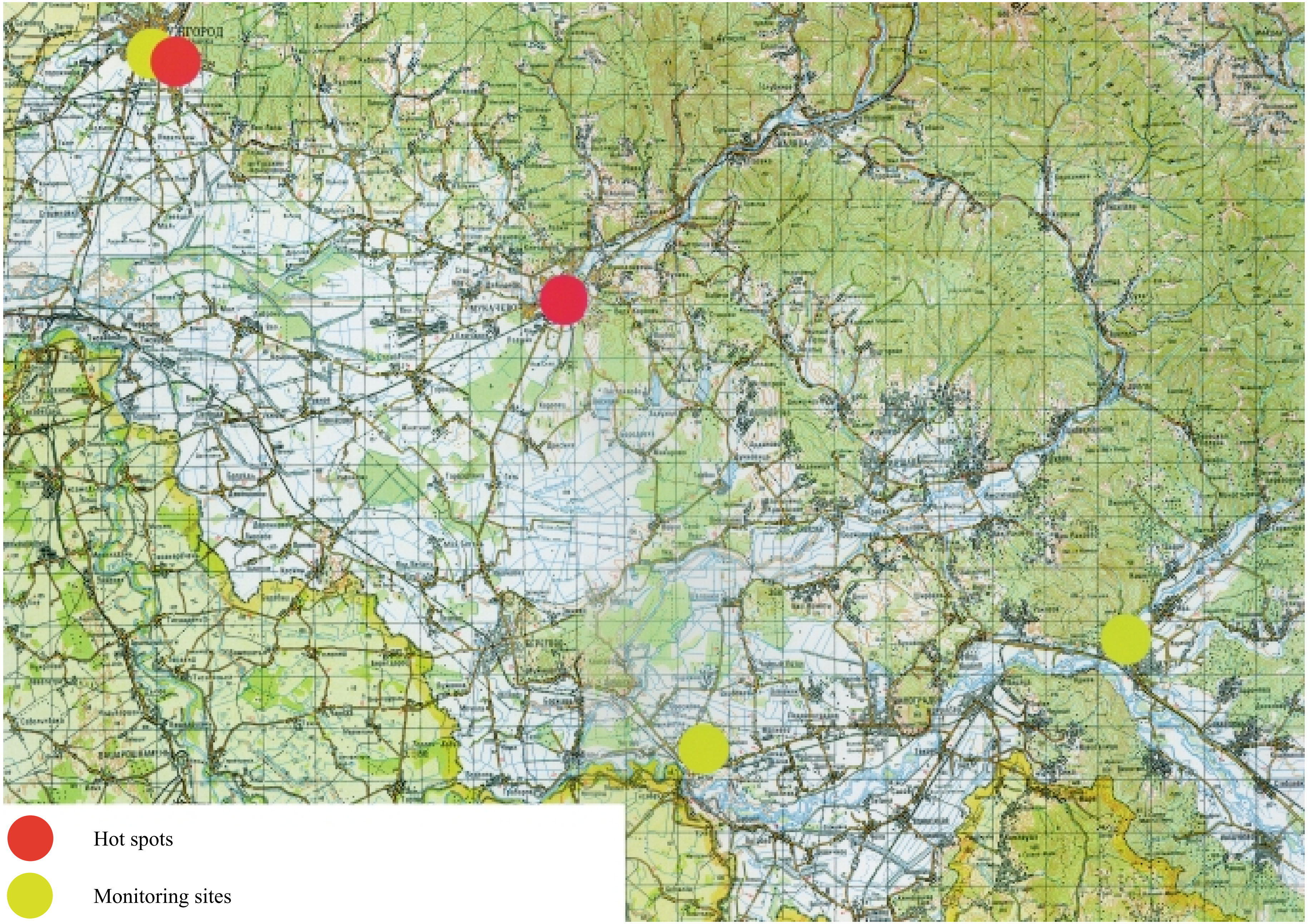
Ukraine, Uzh

variable	y/n	me dium	actual range	analytical method	detection limits
color number	y	w	18-20	Pt-Co scale	1.0
PH	y	w	7.4-7.6	ISO 10523	0.01
flow	y	w	0.23-0.6	hydrometric	0.1
TEMP	y	w	0-21	thermometer	0.1
SS	y	w	1.5-95	gravimetric	

Variable	y/n	medium	actual range	analytical method	detection limits
O2	y	w	7.6-16.9	ISO 5813	
BOD-5	y	w	1.3-5.5	ISO 5815	
COD-Cr	y	w	7.6-24	ISO 6060	
NH4 - N	y	w	0.22-3.55	ISO 5664	
NO2 - N	y	w	0.01-0.15	Photometric	0.005
NO3 - N	y	w	0.55-4.25	ISO 7890-3	
O - PO4 - P - DIS	y	w	0.01-1.55	ISO 6878	
P - TOT	y	w	0.05-2.08	PHotometric	0.02
CL	y	w	8.4-46.8	ISO 9297	
SO4	y	w	26.9-181	ISO 9280	
FLUOR	y	w	0.7-1.6	Photometric	0.5
SI - DIS	y	w	28-30	ISO 6058	
CA - DIS	y	w	0.02-0.35	ISO 7875-1	
SYNDETS	y	w, ss	d.l.-0.000010	GC	0.0000005
A - HCH	y	w, ss	d.l.	GC	
B - HCH	y	w, ss	d.l.-0.000004	GC	0.0000005
C-HCH	y	w, ss	d.l.	GC	0.000002
DDT - SUM	y	w	0.04-1.00	ISO 9377	
OIL	y	w	d.l.-0.013	ISO 6439	
PHENOL-SUM	y	w	2.0-2.4	ISO 6059	
Hardness	y	w	0.001-0.015	ISO 11088	

Maps

Figure 1 Zakarpattia Region (1)



Hot spots

Monitoring sites

Figure 2 Zakarpattia Region (2)

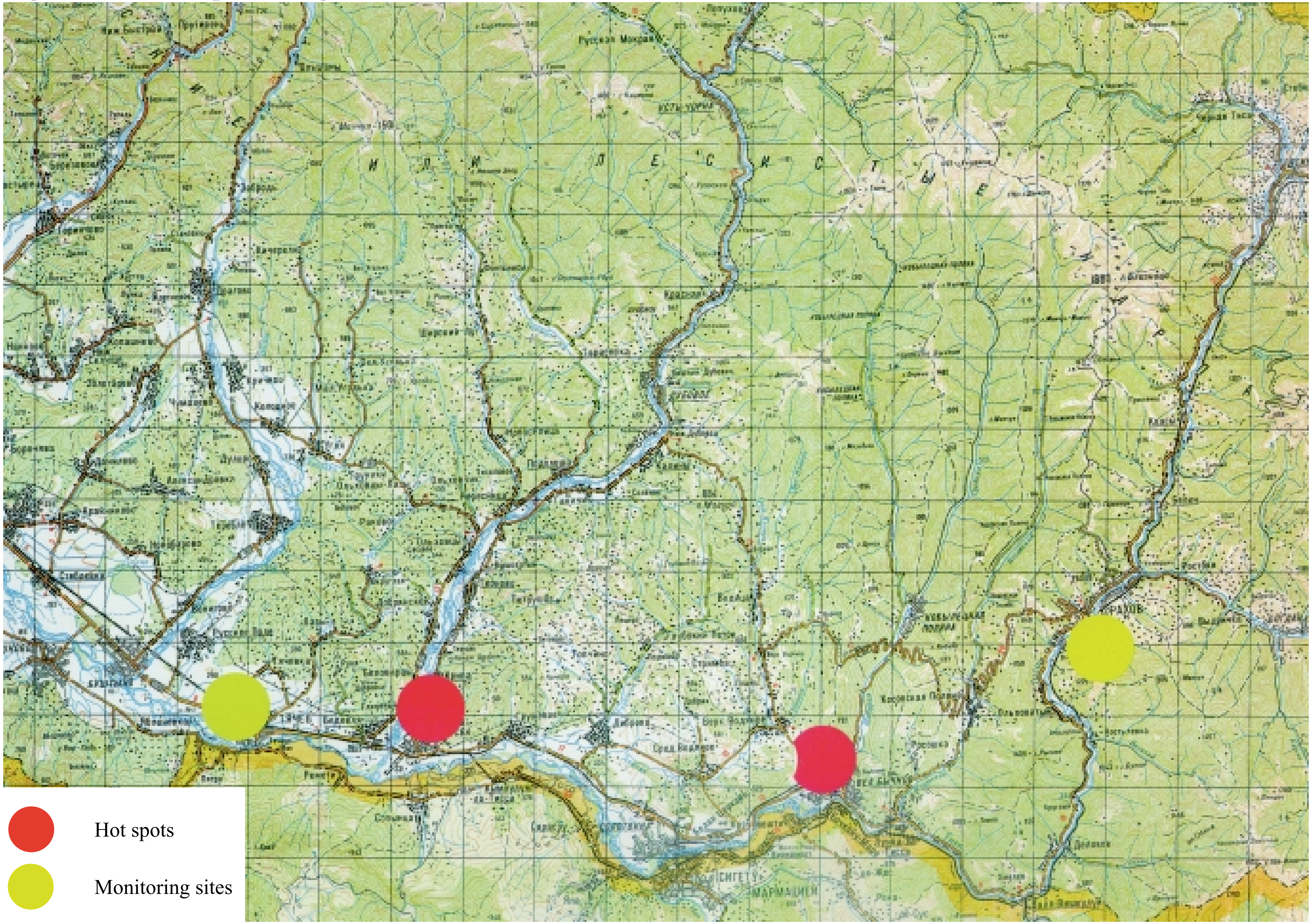


Figure 3 Ivano-Frankivsk region

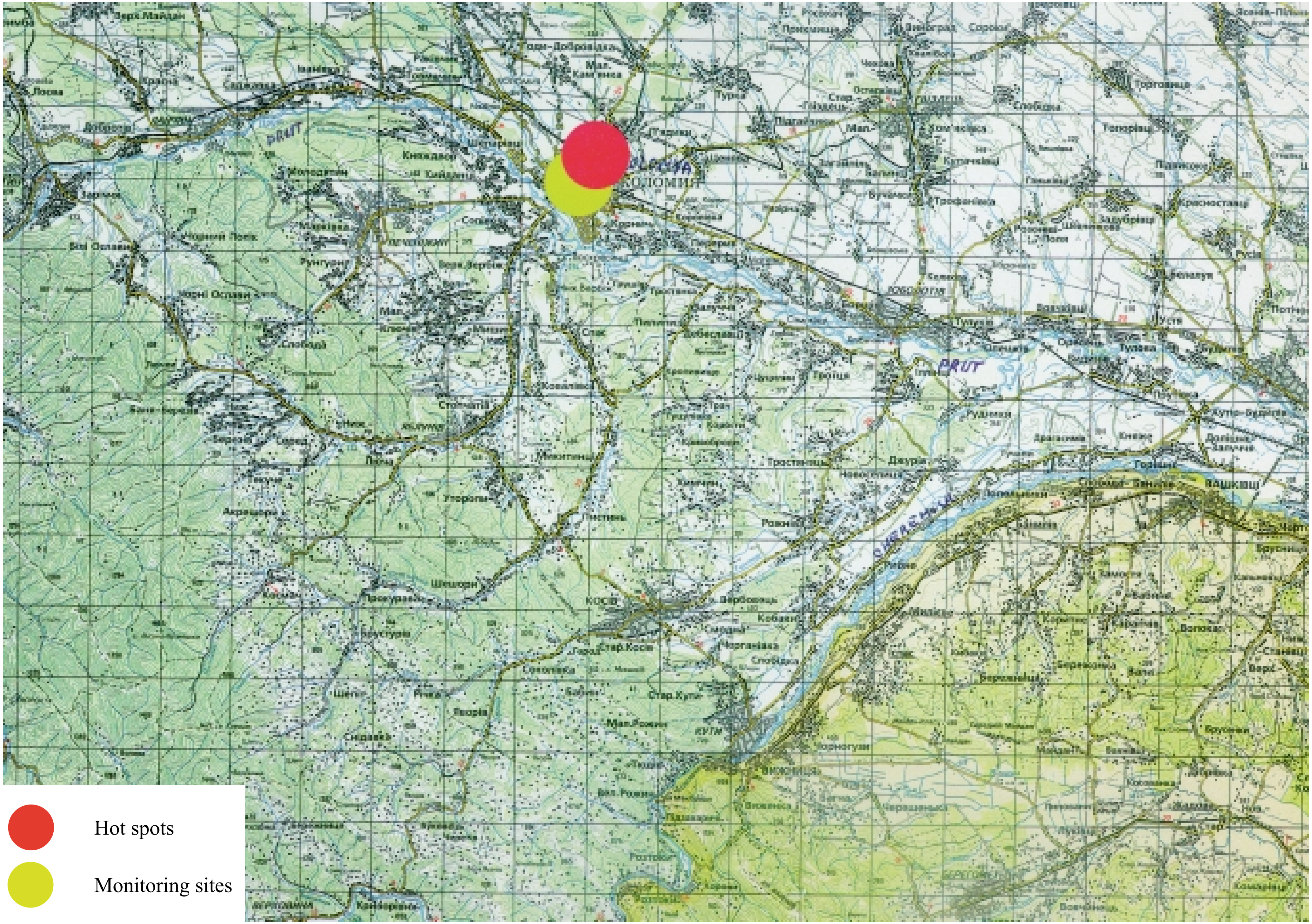


Figure 4 Chernivtsi Region

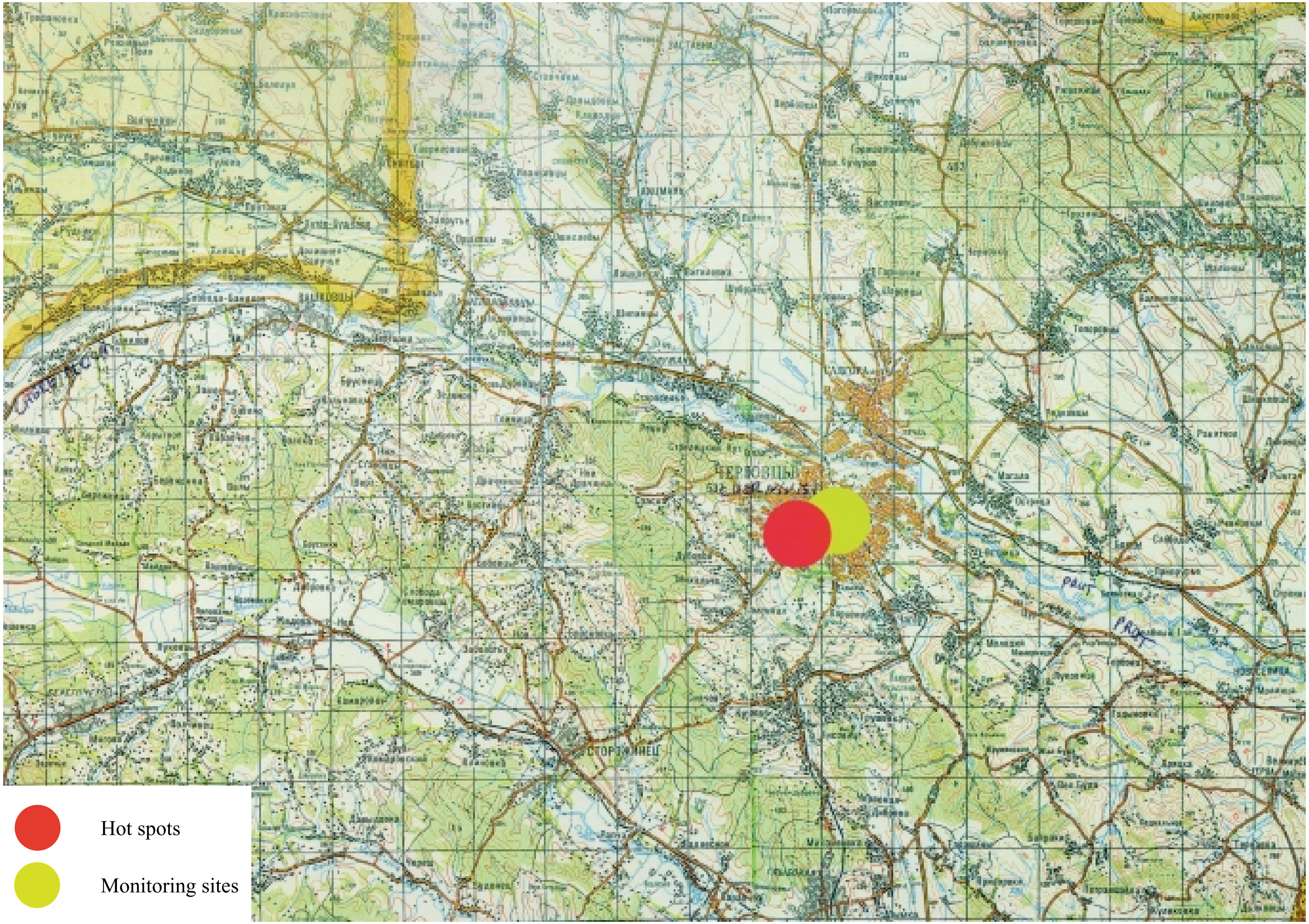


Figure 5 Odessa Region

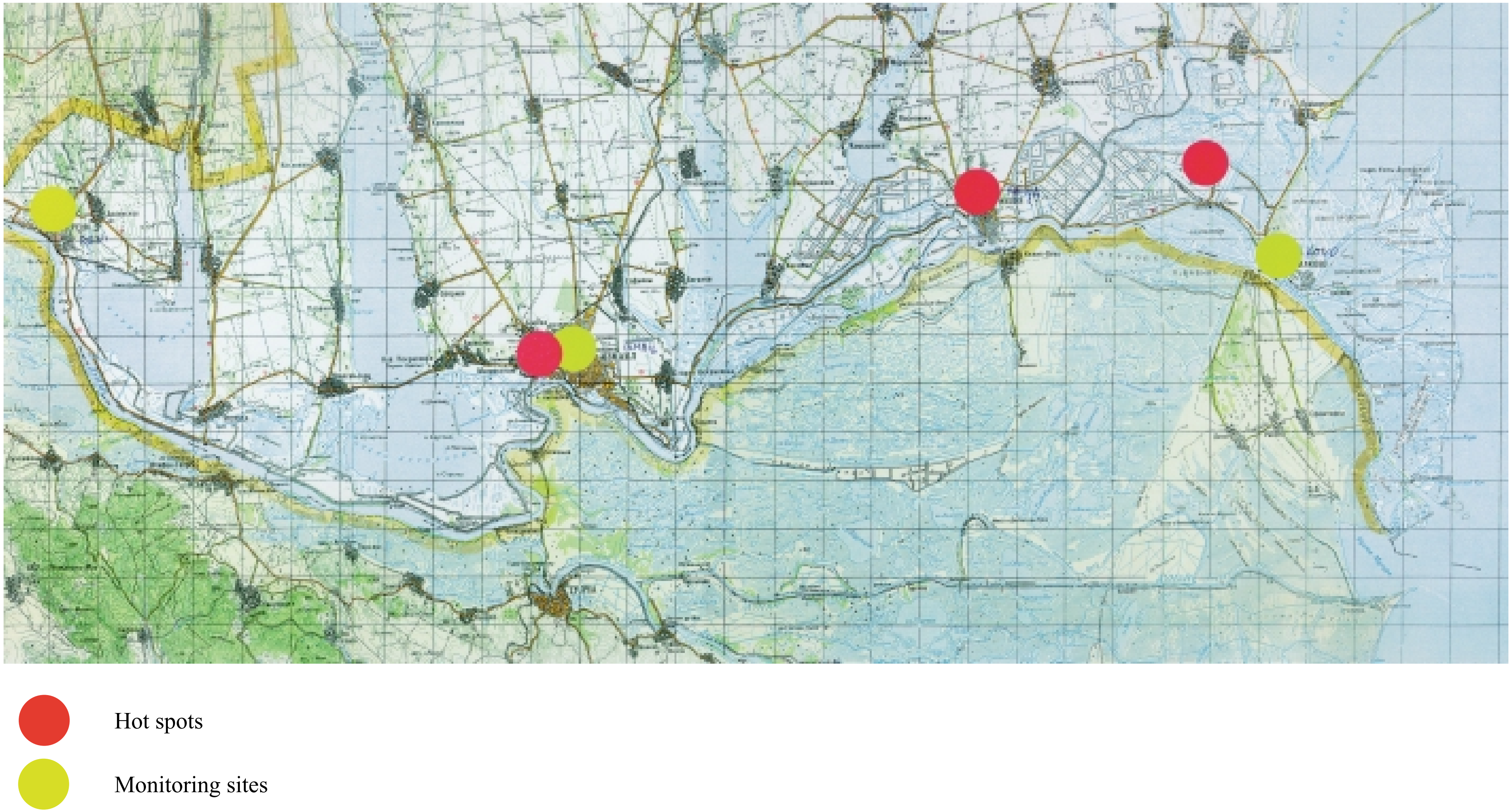
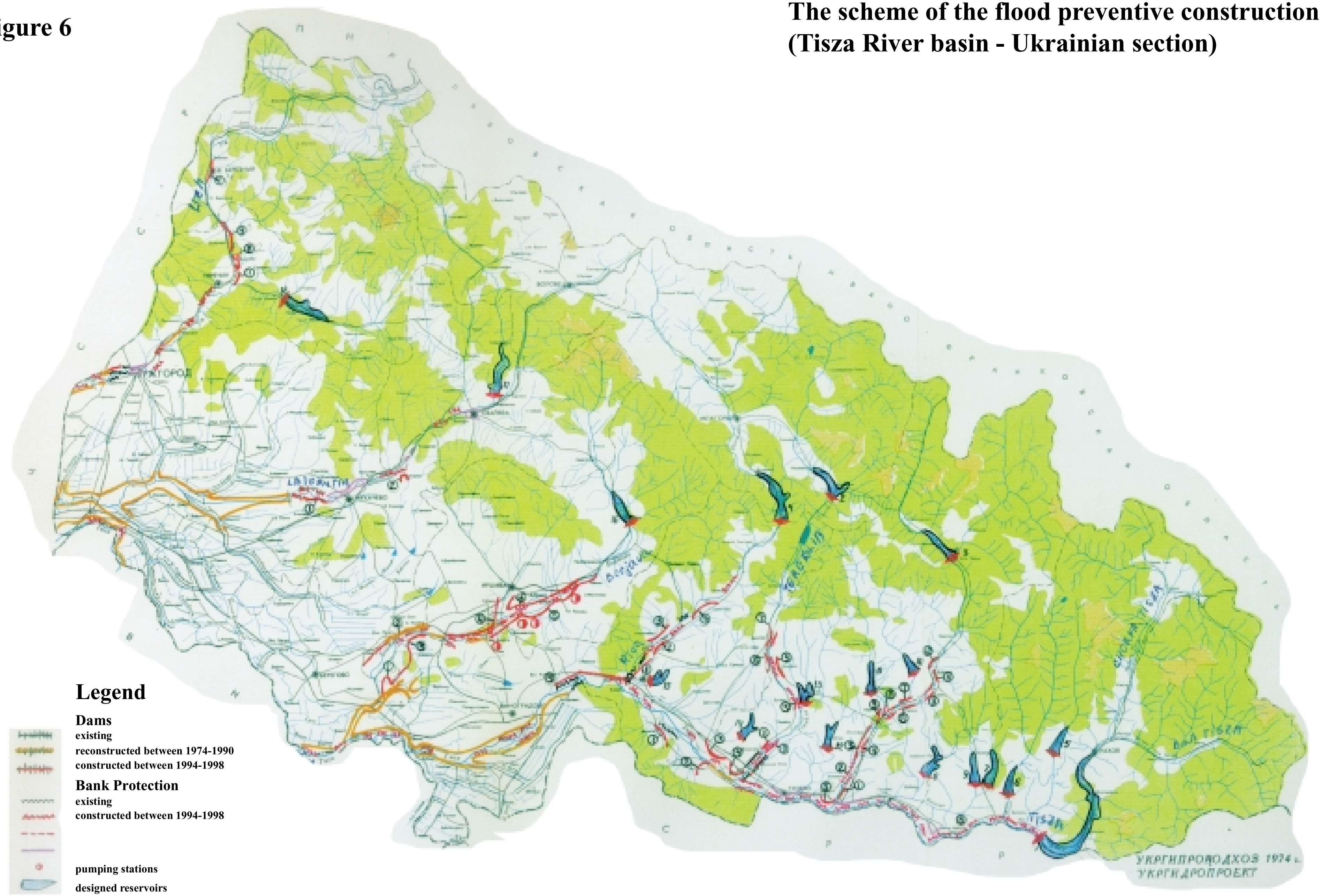


Figure 6

The scheme of the flood preventive construction (Tisza River basin - Ukrainian section)



Bibliography
on Hot Spots and Water Quality

1. Danube Applied Research Programme. Nutrient Balances for Danube Countries. A Report, November, 1997
2. Dumitrache, C. Structure actuelle du zoobenthos de la zone de faible
3. Kharchenko, T.A., Timchenko, V.M., Kovalchuk, A.A. et al. Hydroecology of Ukrainian part of the Danube and adjacent areas.- Kiev: Nauk. dumka Publ., 1993.- 328pp. (in Russian).
4. Kovalchuk, I. Regional Ecologo-Geomotphological Analysis. Lviv Statwe University. Lviv, 1997. 438 P.
5. Ministry for Environmental Protection and Nuclear Safety of Ukraine. (1996) Draft National Action Plan on the Environmental Protection of the Danube River Basin. Kyiv, 1996.
6. Porumb, F. Le zooplancton des eaux roumaines de la mer Noire // Cercertri marine I.R.C.M., 27-28.- 1994-1995.- P. 159-252. profondeur devant les embouchures du Danube // Certet(ri marine I.R.C.M., 24-25.- 1991- 1992.- P. 125-132.
7. State Committee on Land Resources. Draft National Program on Land Restoration. Kiev, 1997
8. State Committee on Statistics. Statistical Bulletin, 1997. Kiev, 1997.
9. State Hydrometeorological Committee. Yearbooks 1994, 1995, 1996.
10. Sukhoyvan, P.G., Mogilchenko, V.I. Ichthyofauna and main commercial fishes biology of the Kilia Danube Delta and Sasik reservoir / In: Gydrobiologia Dunaya y limanov Severo-Zapadnogo Prichernomorya Kiev: Nauk. dumka Publ., 1986.- P. 105-119 (in Russian).
11. Vorobjova, L.V., Garkavaja, G.P., Nesterova, D.A. et al. Zhebrijansky Bay as a model of ecological processes in impact zones of the north-western part of the Black Sea / V.N.Eremeev et al. (eds.), In: Investigations of the Shelf Zone of the Azov-Black Sea Basin, Sevastopol: MHI NAS of the Ukraine Publ., 1995.- P. 44-54 (in Russian).
12. Water Code of Ukraine, 1996
13. Zaitsev, Yu., Mamaev, V. Marine biological diversity in the Black Sea. A study of change and decline.- United Nations Publications, New York, 1997.- 208pp.
14. Zaitsev, Yu.P., Garkavaja, G.P., Nesterova, D.A., Polischuk, L.N. Danube is a main sources of the Black Sea eutrofphication, Hydrobiol. Zhurnal 25(4).- 1989.- P. 21-23 (in Russian).
15. Zambriborsch, F.S., Vinnikova, M.A., Vorobjova, L.V. et al. About hydrobiology of river mouth and coastal waters area of Danube, Limnological investigations of the Danube, Naukova dumka Publ., Kiev, 1960.- P. 456-471 (in Russian).

Part D

Water Environmental Engineering

Table of Contents

Table of Tables

List of Figures

List Of Abbreviations
on Water Environmental Engineering

BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
HRV	National currency (Hryvnya)
MEPNS	Ministry for Environmental Protection and Nuclear Safety of Ukraine
MHP	Ministry of Health Protection
WWTP	Wastewater Treatment Plant
NSAU	National Space Agency of Ukraine
SCWR	State Committee on Water Resources
SCGMR	State Committee on Geology and Mineral Recourses
SCHM	State Committee of Hydrometeorology
SCHBR	State Committee for Housing and Billing Policy
2 TP-vodgosp	Official State statistic information about water use
MCP	Maximum Permissible Concentrations
t. per year	Tons per year
Th. m^3 per year	Thousand of cubic meter per year
TPE	Total Population Equivalent

Glossary
on Water Environmental Engineering

watershed basin	part of earth surface and soils, from which water drains into water stream or water reservoir;
water reach	section of the river, located upstream or downstream water hydraulic facility (dam);
drainage water	water that is disposed of by a drainage system after being filtered out from particular territory, in order to lower level of ground water;
wastewater	water, resulting from domestic and industrial activities (except mine, quarry and drainage waters), as well as water formed on an urban territory owing to falling out of atmospheric precipitation;
waters	all waters (surface, ground, sea ones) inherently present in natural water circulation;
ground waters	waters located below earth surface level within mountain rocks of high part of earth crust, in all physical states;
surface waters	waters in different water bodies located on the earth surface;
water body	natural or artificially created peace of landscape or geological structure, where the waters concentrate (a river, a lake, a sea, a reservoir, a channel, an aquifer horizon);
water resources	volumes of surface, ground, and sea waters of the appropriate territory;
water availability	a characteristic of river run-off per definite period of time in comparison to its mean annual value;
water balance	relationship between water resources available for use within a given territory and actual water needs for economic development, at different levels;
water intake	a construction or an appliance for extraction of water from water body;
reservoir	a surface water body with slow run-off or without it;
water use	usage of waters (water bodies) for satisfaction of residential and industrial needs;
water reservoir	an artificial reservoir with volume of more than 1 million cubic meters, constructed for storage of water and run-off control;
contamination of waters	unfavorable changes of water composition and properties of the water body as a result of entering polluting substances;
polluting substance	a substance that causes worsening of water quality;

flood lands	by-river territory, that can be flooded or wetted during spring floods (high floods);
sanitary protection zone	the territory and the water area where a special sanitary-epidemiological regime is established to prevent worsening of water quality of sources of centralized communal-drinking water supply, as well as to ensure protection of water supplying systems;
water extraction limit	maximum volume of water permitted for extraction from water body, being defined in the permit for special water use;
low water period	a period of annual cycle, when low water is observed;
water monitoring	a system of observations, collecting, processing, storage, and analysis of information concerning the state of waters, forecast of its changes and development of scientifically substantiated recommendations for making relevant decisions;
lake	natural depression filled in with sweet or salt water;
fishery water body	the water body (its part) that is used for fishery purposes;
pond	artificially created reservoir with volume not more than 1 million cubic meters;
water quality	characteristics of composition and properties of water which determine its fitness for concrete purposes of use

1. Summary

National Targets and Instruments for Water Pollution Reduction

The integration in the European Union identified as an objective of international policy of Ukraine implies the sustainable natural resources use, improvement of environmental health and ecosystems restoration. Heavy environmental problems inherited from the former Soviet Union with its extensive style of resources use and mismanagement are on the top of national priority list for actions. Additional burden of Chernobyl accident and its long term impact on population and the environment along with scarcity of resources for improvement of deteriorated environment are very difficult to deal with and distract a good deal of the resources from other priority environmental problems. The national targets in the environmental policy of Ukraine are listed as follows:

- the ecological safety of nuclear installations and protection of population and the environment against radiation hazard;
- improvement of quality of the environment and drinking water in the Dnipro River basin
- improvement of the quality of the environment in urban and industrial regions, in particular the Donetsk-Prydniprovye region;
- pollution reduction from municipal sources;
- pollution prevention and recovery of ecosystems of the Azov and Black Seas;
- transition to sustainable use of natural resources and minimization of human impact on the environment;
- conservation of biological and landscape diversity, expansion of the network of national parks and reserves.

To ensure the implementation of national environmental targets Ukraine continues to develop and refine legislative and regulatory tools, promote economic incentives for sustainable natural resources use, expand and conserve unique natural ecosystem through creation of national park and reserves, encourage ecologically sound technologies and industries, carry out fundamental environmental studies and educate general public. The serious attention is paid to upgrade waste treatment technologies, energy saving and development of alternative energy sources. Considering heavy economic conditions Ukraine is actively seeking technical, technological and financial assistance to deal with its environmental problems.

1.1. Measures to Reduction of Water Pollution.

- Public control of water resources use, protection, and restoration,
- State water quality monitoring,
- Environmental impact assessment survey,
- State water accounting,
- State accounting of water use and water pollution,
- Conducting of the State Water cadaster,
- State accounting of surface waters and state accounting of ground waters,
- Organizational-economic measures which provide water resources rational use, protection, and restoration envisage:
    1. issuing permits for special water use;
    2. establishment of norms and amounts of payments for water extraction and polluting substances discharge;

3. establishing norms and amounts of payments for water use in hydropower generation and water transportation;
4. granting tax, credit and other privileges to water users if they implement low-waste, waste-free, energy- and resource-saving technologies, perform other measures in compliance with legislation that reduce negative effect on waters;
5. compensation of damage for water bodies resulting from violation of legislation, according to the established procedure.

- Standardization and regulation in the area of water resources use, protection and Restoration

The following standards are established in the area of water resources use, protection, and restoration:

- standards of ecological safety of water usage:
  1. maximum allowable concentrations of substances in water bodies, water of which is used for satisfaction of drinking, communal and other needs of population;
  2. maximum allowable concentrations of substances in water bodies, water of which is used for fishery needs;
  3. permissible concentrations of radioactive substances in water bodies, water of which is used for satisfaction of drinking, communal and other needs of population.
- ecological standard of water quality in water bodies;
- standards of maximum allowable discharge of polluting substances;
- industrial technological standards of generation of substances that are discharged into water bodies;
- water usage technological standards;
- standards of maximum allowable discharge of polluting substances are established with the aim of stage-by-stage attaining the ecological standard of water quality for water bodies.
- Establishing, according to the Regulation on Development and Approval of Norms of Maximum Permissible Discharges of Pollutants, and an Inventory of Pollutants whose Discharge is Subject to Regulation Lists, of priority substances A, B, C.
- The state water monitoring is conducted with the aim of ensuring collection, processing, storage and analysis of the information on the condition of waters, prediction of its changes, and development of the recommendations for making scientifically substantiated decisions in the field of water usage and protection and water resources restoration.

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

Of the identified in Chapter “Water Quality” hot spots and planned measures on reduction of transboundary impact the most important are the following:

reconstruction and modernization of wastewater treatment facilities of Izmail cardboard factory that will result in reduction of adverse impact on the Black Sea coastal waters and fragile ecosystem of Danube delta;

reconstruction of Uzhgorod wastewater treatment facilities for reduction of nitrogen, phosphorus, and easily oxidized organic matter (measured as BOD) load. At present the Uzhgorod wastewater treatment facilities (capacity 50 Th. m^3 per day) operates with 100 Th. m^3/per day of municipal wastewater and discharge annually 13 mln. m^3 of insufficiently and untreated municipal wastewater into transboundary river Uzh, a tributary of Bodgoh (Tisza). If the project is not implemented the increased untreated municipal wastewater discharge will result in deterioration of the water quality for drinking water purposes in Slovakia that has first drinking water intake facilities at 3 km downstream from the river Uzh.

Considering regional impact of Ukraine Rakhiv and Teresva timber processing factories should be taken into account because these enterprises are the major source of pollution with phenols, heavy metals and oil products.

2. National Targets and Instruments for Water Pollution Reduction

2.1. Actual State and Foreseeable Trends in Water Management With Respect to Water Pollution Control

There is pollutants discharge to the Danube basin from municipal wastewater facilities belonging to Uzgorod, Izmail, Kolomia.

Reduction of the total pollution load allocation (excluding heavy metals) was monitored for basins of Dnister, Siversky Donetz and Western Bug Rivers. In areas downstream of the large towns problems with heavy metals still remain and additional construction of the local industrial wastewater treatment plants should be in consideration to eliminate their impact on the environment. Basins of the Dnipro and Danube Rivers still remain polluted with oil products, suspended matters and nitrogen of ammonia. Quality of 6% of the centralized, about 12% of municipal and 7% of departmental drinking water supply systems is not in compliance with hygienic and sanitary standards and norms resulting from insufficient quality of abstracted water, absence of areas with sanitary protection and sanitation equipment. Due to widespread chemical and bacterial pollution of the local water sources, drinking water resources are insufficient in rural areas. Each eighth sample of the drinking water taken from the rural drinking water wells and each third sample from the sources of non centralized drinking water supply do not comply with bacteriological hygienic standards.

Sometimes in Ukraine arise problems dealing with epidemiological situation on many infection diseases. Entheroviruses occur in 10 - 15% of raw river water samples and in less than 15% of marine water samples.

Except the eastern part of Ukraine ground water quality is more stable. Ground waters are impacted by industrial and mining especially by producing wastewater storage reservoirs and discharges.

Table 2.1. Level of the microbiological contamination as a oblast profiles

Regions	Water Bodies Classified as 1 class		Water Bodies Classified as 2 class	
	Indexes	Pathogenic microbs	Indexes	Pathogenic microbs
Zakarpatska	4,7	0	8,2	0
Ivano-Frankivska	21,4	0	13,8	0
Odesska	24,5	4,3	34,1	4
Chernovitska	3,4	0	35,9	5,1

Table 2.2. **Pollution substances input in the Danube basin from the point-sources**

Name of the water body	Year	Name of the pollutant								
		BODt	Oil Products	Suspended Solids	Nitrogen of Ammonia	Cu2+	Zn2+	Cr(t)	Phenols	Fe(t)
		tons/1000	tons	tons/1000	tons	tons	tons	tons	tons	tons
Danube River basin	1995	3,2	2,7	3,5	0,5	0,8	1,7	0,44	0,14	13,7
	1996	2,3	0,44	3,8	0,5	0,39	1,2	0,59	0,07	9,5
	1997	2,3	3,0	5,2	0,6	0,58	0,	0,37	0,001	8,4

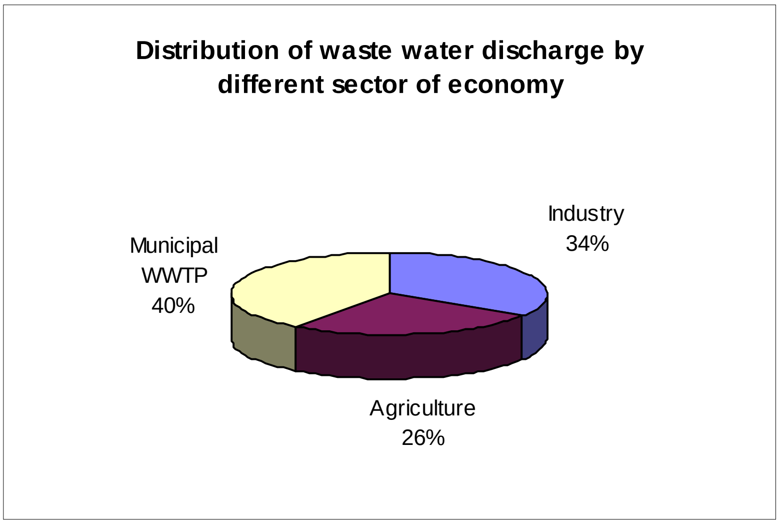


Figure 2.1. Distribution of the wastewater discharge by the different sectors of economy

Main problems of water pollution are related to the drawbacks of former water management system:

- main technological processes were biological treatment technologies including aerobic and anaerobic processes and chemical treatment for reduction of nitrogen and phosphorus contents
- construction and reconstruction wastewater treatment facilities have been carried out without consideration of regional social and economic development that resulted in significant overload of wastewater treatment facilities.

2.2. National Targets for Water Pollution Reduction

According to the Water Code of Ukraine the purpose of the water resource management policy in Ukraine in an improvement of the water quality and rational use of water for providing of sustainable different water use as well as reviving and sustainable existence of water's ecosystems.

The short term objectives (for period to 2000) of water resources management should be:

- normative and legal maintenance of the new Ukrainian water legislation;
- development of the ecological normative on water quality (standards) with short and long term stages for their implementation;
- organization of the State Monitoring System of the waters;
- improvement of the water quality/quantity control through the water objects pollution reduction control;
- establishment of the technological regulating systems of water use and pollution of water objects in sources of contamination;
- ecological and economical substantiation of charges for water use/pollution to be sure that "polluter - pays and user - pays" principle is applied in practice.

The long-term objectives (for period to 2015) should be:

- harmonization of the Ukrainian and European Community (EC) legislation;
- organization of the legislative and economical substantiation of the water resources management based on the basin principle.

International obligations of Ukraine

Referring to Ukraine, it should be emphasized that development of National Environmental Strategy of Ukraine is now at the last phase of elaboration. The key document - “Main Directions of the State Policy in the Field of Environmental Protection, Natural Resources Use and Environmental Safety” was adopted by the Parliament of Ukraine. This document clearly defines the key priorities of Environmental Policy and Practical Actions including International obligations of Ukraine. These are as follows:

1. Assurance of nuclear and radiation safety, overcoming of the consequences of Chernobyl Nuclear Power Plant disaster.
2. Conservation of landscape and biological diversity.
3. Improvement of the state of the environment in the Dniper Basin and potable water quality.
4. Prevention of pollution and improvement of the environment of Black Sea.
5. Improvement of environmental state in the Donetsko-Prydniprovsky Industrial Regions.
6. Construction and reconstruction of municipal sewage systems.

As we can see, three of the defined priorities are directly related to the sustainable water management and clearly stipulate the necessity of consolidation of national intersectoral and international efforts for practical actions.

Priorities for transboundary co-operation

By the present time the Ministry for Environmental Protection and Nuclear Safety of Ukraine has adopted four co-operation programmes for transboundary rivers in Danube basin:

Table 2.3. Priorities for transboundary co-operation

River basin	Riparian countries	Defined or possible sources of financial assistance
Dniper	Russia, Belarus	GEF with additional national support
Danube	Romania	PHARE Danube basin environmental programme
Tissa	Romania, Hungary	PHARE Danube basin environmental programme
Latoritsa/Uzh	Slovakia	The TACIS 1997 Cross - Border project
Prut	Romania, Moldova	Will be initiated as the TACIS 1998 Cross - Border project
Western Bug	Poland, Belarus	The TACIS 1997 Cross - Border project
Siverskiy Donets	Russia	Will be initiated as the TACIS 1998 Inter State project
Dnister	Moldova	Initiated as the US AID project

Alongside with the activity of Ukraine to ratify the Helsinki 92 Convention, the Ukrainian Government has adopted the following agreements:

- The Agreements between Ukraine and Russia on the common use and protection of water resources of Siverskiy Donets River,

- The Agreements between Ukraine and Moldova on the common use and protection of water resources of Dnister River,
- The Agreements between Ukraine and Poland on the boundary control of the water quality of Western Bug and other rivers.

There are many agreements concerning the cross-border control of the water quality between Ukrainian regional nature protection departments and similar departments in Hungary, Poland, Slovakia, Belarus.

Black Sea matters

Along with the independence, Ukraine gained the status of a marine State. But the Black Sea which Ukraine has access to, is an internal sea and, unfortunately is on the list of the most polluted seas in the world. The situation with the Black Sea has not always been like this. The Black Sea is a unique marine natural system with its bioproductive, recreational and potential capacities. Huge productive potential of the Black Sea and its basin has been providing the Black Sea area inhabitants with all the necessary-for-life products for thousands of years. In the beginning of the 20th century one could still get an impression of the guaranteed endless use of its resources. But the exceeding use of the marine resources and the use of the Black Sea as the reservoir for wastes disposal, especially during the period of the last thirty years, have caused catastrophic degradation of its environmental system and drastic reduction of its productivity.

Ukraine has the longest coastal line in this rather inhabited region. That is why its environment has always been a subject to close attention and major concern for the Ukrainian Government.

But Ukraine is not the only country to use the resources of the Black Sea, and the infinite contamination of marine environment comes from the collector basin, the surface of which several times exceeds the surface of the Black Sea itself. The Black Sea gathers a convincing number of 17 countries around it. Thus, the solution of the Black Sea environmental problems is impossible without thoroughly considered international co-operation. The commitments undertaken by the Black Sea countries concerning the protection and use of its resources is set out in the Convention on the Black Sea pollution protection (done in Bucharest in 1992) that is the basic legal title defining the priorities and directions of the international nature protection activities in the Black Sea basin. The Convention was ratified by all the Black Sea countries. The general nature protection policy is outlined in the Odessa Declaration signed by the Ministers of environment protection of Bulgaria, Georgia, Russia, Romania, Turkey and Ukraine in 1993. Practically the Declaration gave the start to the idea-generating process that was later put into words in the Convention of Bucharest.

It was under this legislation base that the International Programme ’Management and protection of the Black Sea’ for the years of 1993 - 1997 to assist the Governments of Bulgaria, Georgia, Russia, Romania, Turkey and Ukraine to carry out the provisions of the Convention, was implemented under the umbrella of GEF. The Programme consisted of 3 components and was oriented on:

- strengthening of nature protection potential;
- policy development;
- attraction of large-scale investments.

The Programme had exclusively positive influence on consolidation of the international efforts in the field of control for marine environment pollution and use of its natural resources.

The intentions of the Black Sea countries to save the Black Sea from further degradation were stated in the Programme document that is in the Strategic Action Plan for the Black Sea (signed on 31 of October 1996 by Ministers of Environment of the Black Sea countries). As a development of the provisions of the mentioned Plan there was elaborated a draft of the State Programme for Protection and Remediation of the and Black Sea in Ukraine that is being now approved by the government institutions of Ukraine.

The Black Sea is of a great importance to Ukraine. Its considerable biological, mineral and recreational resources are crucial for the sustainable development of the economy of the coastal regions of Ukraine. It is worth stressing the unique recreational capabilities of the Black Sea for improvement of the health state of the population of Ukraine, as well as on the Black Seas significant role as the marine transport route. That is why, notwithstanding the serious economic conditions and difficulties accompanying the establishment of the installation Ukrainian State, the latter has never stopped the activities aimed at reduction and cessation of pollution of the Black Sea from the territory of Ukraine, prevention from further degradation of its environmental systems, preservation of its biodiversity and recovery of bioproductivity. Application of the international experience, attraction of technical assistance and investments, active international co-operation in implementing of the Bucharest Convention, the Odessa Declaration and Strategic Action Plan will allow to hope that the Black Sea will be preserved for future generations.

According to the Water Code of Ukraine water resources management is carrying out with respect to National, International and Regional Programmes in Water Resources Use, Protection and Restoration.

National, international and regional programmes on water resources use, protection and restoration are developed in order to provide implementation of effective measures for satisfaction of domestic and industrial water needs, rational use and protection of waters, prevention of their adverse action.

National, international and regional programmes on water resources use, protection, and restoration are developed on a basis of data of state water accounting, water cadaster, schemes of water resources use, protection, and restoration, etc.

Development and implementation of these programmes are funded by the national budget of Ukraine and local budgets, resources of enterprises and organizations, off-budget funds, voluntary donations of organizations and citizens and other budgets.

There are some State Programmes in the Danube basin, which relate to both environmental protection and water protection. These are "The Programme on Development of Drinking Water Supply and Municipal Sewer Systems of Ukraine", "The Integral Programme of Flood Routing in Ukraine", and "Programme of Development of Nature Conservation" that are currently approved by the Verkhovna Rada (Supreme Counsel) of Ukraine and by the cabinet of the Ministers. These programmes have a status of national law. Additionally there are several regional (oblast) environmental protection programmes.

2.3. Technical Regulation and Guidelines

The status of regulatory documents and pollution control is identified and approved at the level of the Cabinet of the Ministers in a form of amendments or detalization of acting legislative norms.

There are several documents in Ukraine dealing with the monitoring, control etc.:

- On Approval of Regulation for Determination of Sizes and Boundaries of the Water Protection Areas and Regime of Economic Activity within These Areas
- On Approval of the Guidelines for Execution of the State Ecological Examination
- On the List of Sections of the Bodies of Water Used
- For Commercial Fishing (Parts of Them)
- On Approval of Regulation on Protection of Internal Sea Waters and Territorial Sea from Pollution and Littering

- On Approval of Regulation on Reimbursement of Losses of Water Users, Resulting from Cessation of Right or Changes in Conditions of the Special Water Use
- On Approval of Regulation on Conducting State Water Monitoring
- Regarding Regulation on Development and Approval of Norms of Maximum Permissible Discharges of Pollutants, and an Inventory of Pollutants, Whose Discharge is Subject to Regulation
- On Approval of Regulation on Water Fund Lands Use

The following standards are established in the area of water resources use, protection, and restoration:

1. standards of ecological safety of water usage;
2. ecological standard of water quality in water bodies;
3. standards of maximum allowable discharge of polluting substances;
4. industrial technological standards of generation of substances that are discharged into water bodies;
5. water usage technological standards.

Other standards in the area of water resources use, protection and restoration could be established by legislation of Ukraine.

2.3.1. Standards of Ecological Safety of Water Usage

To assess possibility of using water from water bodies for satisfaction of domestic and industrial needs, standards are established, which ensure safe conditions of water usage, namely:

- maximum allowable concentrations of substances in water bodies, water of which is used for satisfaction of drinking, communal and other needs of population;
- maximum allowable concentrations of substances in water bodies, water of which is used for fishery needs;
- permissible concentrations of radioactive substances in water bodies, water of which is used for satisfaction of drinking, communal and other needs of population.

If necessary, more stringent standards of ecological safety of water usage could be established for waters in water bodies that are used for healing, resort, health, recreational, and other purposes.

Standards of ecological safety of water usage are developed and approved by:

- the Ministry of Health Protection of Ukraine and the National Commission on Radioactive Protection of Population of Ukraine - for water bodies, water of which is used to satisfy drinking, communal and other needs of population;
- the Ministry of Fishery of Ukraine - for water bodies, water of which is used for needs of fishery.

Standards of ecological safety of water usage are put into effect with agreement of the Ministry of Environmental Protection and Nuclear Safety of Ukraine.

2.3.2. Ecological Standard of Water Quality in Water Bodies

To assess ecological well-being of the water bodies and to determine a set of water-protection measures, an ecological standard of water quality in water bodies is established, which contains scientifically substantiated values of concentrations of polluting substances and water quality indicators (physical, biological, chemical, radioactive). An extent of water pollution is determined by water quality categories.

Ecological standard and categories of water quality for water bodies are developed and approved by the Ministry of Environmental Protection and Nuclear Safety of Ukraine and the Ministry of Health Protection of Ukraine.

2.3.3. Standards of Maximum Allowable Discharge of Polluting Substances

Standards of maximum allowable discharge of polluting substances are established with the aim of stage-by-stage attaining the ecological standard of water quality for water bodies.

Procedure for development and approval of standards of maximum allowable discharge and a list of polluting substances covered by the standards are established by the Cabinet of Ministers of Ukraine.

2.3.4. Industrial Technological Standards of Generation of Substances that are Discharged into Water bodies

To assess an environmental safety of the industry, the industrial technological standards of generation of substances discharged into water bodies, that is, standards of maximum allowable concentrations of substances in wastewater generated while manufacturing one type of product with same raw materials, are established. Industrial technological standards of generation of substances discharged into water bodies are developed and approved by the relevant ministries and agencies with agreement of the Ministry of Environmental Protection and Nuclear Safety of Ukraine.

2.3.5. Technological Standards of Water Usage

To assess and provide rational usage of water in economic branches, the following technological standards of water usage are established:

- current technological standards - for existing level of technologies;
- perspective technological standards for water use - with account of achievements of advanced world technologies.

Technological standards of water usage are developed and approved by relevant ministries and agencies with agreement of the Ministry of Environmental Protection and Nuclear Safety of Ukraine.

2.3.6. Regulation of Discharge of Substances, for which Standards in the Area of Water Resources Use, Protection, and Restoration are not Established

Discharge of substances, for which standards of ecological safety of water usage and standards of maximum allowable discharge are not established, is prohibited.

Discharge of these substances can be allowed in exceptional cases by the Ministry Of Health Protection of Ukraine, the Ministry of Environmental Protection and Nuclear Safety of Ukraine and the Ministry of Fishery of Ukraine on a condition that these standards will be developed and approved during the established period.

Development of standards of ecological safety of water usage and standards of maximum allowable discharge for these substances is ordered by water users, who discharge those substances.

2.4. Expected Impacts of EU-Directives to Water Pollution Control

The harmonization of Ukrainian Legislation with European-Directives has been carried out for three main directives.

- EU Directive 96/61/EU of September, 1996 on control and prevention of pollution
- EU Directive 91/271/EU of May 21, 1991 on municipal wastewater treatment
- Draft EU Directive "On EU Principles of Water Management"

Further activities on harmonization of Ukrainian environmental legislation with EU Directives will be carried out providing availability of financial sources.

General comments on correspondence of Ukrainian legislation to EU-directives

For harmonization of Ukrainian acting legislation with above-mentioned EU Directives the following priorities should be considered:

1. measures not connected with significant financial resources, including amendments and additions to the acting legislation, regulations, standards and their presentation
2. measures requiring affordable finical resources: improvement of control system, and optimization of monitoring that satisfy the information needs of environmental management; an enforcement system for improved environmental legislation for water users and polluters of water resources
3. measures that will require significant financial investments (including international investments): reconstruction and improvement of existing manufacturing and wastewater treatment technologies; construction of new wastewater treatment facilities (in compliance with EU Directives 91/271/ªÑ of May 21, 1991 on municipal wastewater treatment)

The identification of financial needs for harmonization of environmental legislation of Ukraine and EU-directives requires a separate study.

2.5. Law and Practice on Water Pollution Control

2.5.1. Legislation and Regulations

According to Ukrainian environmental legislation (regulations) economic branches try to implement their policies with no deviations the "polluter pays" principle which, inter alea, foresees payments for purposive use of natural resources, for pollutions caused to the environment, including fees for effluence, as well as for the worsening of natural resources' quality. This policy is based on a system of water quality environmental standards, which are sanitary norms similar to maximum permissible concentration, according to which utilities-polluters are given limitations for effluents. It is generally accepted, at least theoretically, that such a policy has to encourage industrial installations to save water resources and reduce volumes of effluents pursuant to fixed maximum permissible levels. This policy does not envisage establishing of "technological standards for effluents" to certain industrial facilities taking into account the capacities of available techniques since the environmental regulations of Ukraine have no provisions similar to RACT, BATNEEC or BACT principles. There are only particular branch norms for operating of clean-up facilities to be approved by the highest officials dealing with the corresponding branch. However, these norms are not prescriptive. All regulatory requirements regarding the operation of clean-up facilities are laid down by the Ministry for Environmental Protection and Nuclear Safety of Ukraine (MEPNS of Ukraine) in design documents and authorizations (licenses) for special use of water.

The principal environmental regulation of Ukraine is the Ukrainian Law "On Protection of the Environment" of June 25, 1996. This law establishes the basic principles for protection of the environment. It regulates relationship in the field of protection and recovery of natural resources, ensures the environmental security, prevents deleterious effects on the environment by industrial and other activity. Another important regulation is the Water Code of Ukraine. Below are some measures aimed at compliance with the environmental regulations by utilities of no matter which form of property;

- the conduct of environment examination (expertise) pursuant to article 26 of the Law "On Protection of the Environment". The procedures to conduct such an examination are established by the instruction (explanatory note of prescriptive character) that was approved by internal ordinance #15 of February 17, 1994 by the Ministry for Environmental Protection of Ukraine;
- fees for specials use of natural resources (Article 43), fees for causing pollutions of the environment, including fees for effluence (Article 44), fees for the worsening of the quality of natural resources (Article 45), amount of which has not been fixed yet.
- State and public monitoring over compliance with environmental legislation (Article 9);
- prevention of environmental infractions through setting constrains or suspending of environmentally hazardous activities or even cession of such activities in case of reiterative violations of environmental security norms and requirements;
- various kinds of legal liability (criminal, administrative, disciplinary).

The system for environmental standards currently in force in Ukraine is based on sanitary or sanitary-hygienic norms that are referred to maximum permissible concentrations, i.e. the concentrations of eventually harmful chemical combinations in air, water and ground, which do not cause pathogenic mutation or deceases following a lasting impact on human body on a day-by-day basis. Maximum permissible concentrations are also referred to in the models for pollutant dissolution in an aquedis environment that are used in order to set limits for effluents released by industrial facilities.

Pursuant to “Rules for Surface Water Protection” (standard provisions) that were approved by the Soviet Union Committee for the protection or/of nature on February 12, 1991 and currently in force in Ukraine, there are 3 category of water quality: for fishery purposes, for domestic purposes, and for household and drinking purposes.

The “Rules” set forth the general requirements to the quality and composition of water in open bodies of water. The Sanitary Rules and Norms (SanPyN #463088) “protection of surface water against pollutions” establish the hygienic requirement to the composition and properties of water in bodies of water in the areas, where water is used for domestic, household and drinking purposes and introduce the limitations for maximum permissible content of harmful substances in such water.

The system for water quality standardization inherited from the former Soviet Union encompasses over 4.000 performances. Each chemical, physical or biological performance, which defines water quality, is attributed norms of maximum permissible concentration for man-induced chemical combinations that can differ considerably depending on water body types and water use purposes (household and drinking, domestic, fishery).

There are approximately 1.000 sanitary and hygienic and 450 fishery norms of maximum permissible concentrations (hereinafter referred to as MPC). MPC norms to 420 harmful combinations have been fixed for bodies of water serving household and drinking purposes; 68 similar performances have been developed to object of water that serves economic purposes. The monitoring of water resources is regulated by “The provisions describing the State monitoring of the environment of Ukraine” that were put in force by the enactment of the Cabinet of Ukraine #785 of August 23, 1993. In accordance with these provisions the monitoring of the Dnieper’s basin water resources is ensured by several State agencies. The State Committee for Hydrometeorology operates the largest surface water quality-monitoring network. That system has been designed mainly to study the country’s water resources. It provides the most efficient services to Carpathian and Crimea Mountains but not to the polluted industrial regions of Ukraine.

2.5.2. Licensing

Enterprises, institutions, organizations and citizens of Ukraine, as well as foreign legal and natural persons and persons without citizenship that extract water from water bodies, discharge reclaimed waters into them or use water bodies in other way, could be regarded as water users in Ukraine.

Water users could be primary and secondary ones.

Primary water users are those users, who possess their own water intake facilities and respective equipment for water extraction.

Special water use is extraction of water from the water body with application of facilities or technical instruments and discharge of reclaimed waters into it.

Special water use is carried out by legal and natural persons, first of all for satisfaction of drinking needs of population, as well as communal, health-healing, health-improvement, agricultural, industrial, transport, energy, fishery and other national and public needs.

Special water use is carried out on the basis of the permit.

Permit for special water use is issued upon the water user's application containing water need explanation, which should be agreed by the state bodies on water resources - when surface waters are used, by the state bodies on geology - when ground waters are used, and by the state health protection bodies - when health-healing water bodies are used.

Procedure of agreement on and issuance of permits for special water use is approved by the Cabinet of Ministers of Ukraine.

Limits for water extraction and polluting substances discharge are specified in the permit for special water use. In case of low water, limit for water extraction could be reduced by specially authorized bodies without correction of the permit for special water use.

Terms of special water use are established by bodies, which issued the permit for special water use.

Special water use can be short-term one (up to 3 years) or long-term one (three to twenty-five years).

Term of special water use could be prolonged for the period that does not exceed relevant short-term or long-term water use, if necessary. Prolongation of special water use terms by the petition of interested water users is carried out by the state bodies that issued permit for special water use.

2.5.3. Monitoring

The state water monitoring is conducted with the aim of ensuring collection, processing, storage, and analysis of the information on the condition of waters, prediction of its changes, and development of the recommendations for making scientifically substantiated decisions in the field of water usage and protection and water resources restoration.

Subjects of the state water monitoring are as follows:

- surface waters;
- natural water bodies (lakes), water courses (rivers, streams);
- artificial water bodies (reservoirs, ponds), channels and other water bodies;
- groundwater and springs;
- internal sea waters and territorial sea; exclusive Ukrainian (marine) economic zone;
- sources of water pollution, including wastewater; accidental discharges of liquid products and wastes; products and material losses in a process of mineral resources extraction within aquifers of surface waters, internal sea waters, territorial sea waters and exclusive Ukrainian (marine) economic zone; as well as dumping of wastes, waters of surface drainage from the agricultural fields, filtration of pollutants from technological water bodies and reservoirs; and massive growth of the blue-and-green algae;
- release of harmful substances from sediments (secondary pollution), and other sources of pollution, which could be subject to observation.

There are approximately 1.000 sanitary and hygienic and 450 fishery norms of maximum permissible concentrations (hereinafter referred to as MPC). MPC norms to 420 harmful combinations have been fixed for bodies of water serving household and drinking purposes. The monitoring of water resources is regulated by “The provisions describing the State monitoring of the environment of Ukraine” that were put in force by the enactment of the Cabinet of Ukraine #785 of August 23, 1993. In accordance with these provisions the monitoring of the Danube basin water resources is ensured by several State agencies. The State Committee for Hydrometeorology operates the largest surface water quality-monitoring network. That system has been designed mainly to study the country’s water resources. It provides the most efficient services to Carpathian and Crimea Mountains but not to the polluted industrial regions of Ukraine.

Sanitary-epidemiological posts reporting to the Ministry for Health Protection of Ukraine ensure constant monitoring of the drinking water quality and domestic water quality on specific sites located along the Danube River and its tributaries. A particular attention is paid by the Ministries to health protection monitoring system to assess the impact of various water pollutants on the general public’s health. The Ukrainian State Committee for Water Management has in operation water monitoring units and receives various data on sewage water effluents transmitted by utilities through forwarding of filled-out forms #2-TP (water management). Once these data are processed and finalized the State Committee for Water Management submits the corresponding informations to the Ministry for Statistics of Ukraine in the form of quantified pollution performance for towns, regions etc.

The Ukrainian Ministry for Agricultural Produce operates monitoring units that measure the content of pesticide and nitric combinations in surface water.

The Ministry for Environmental Protection and Nuclear Safety of Ukraine is not able to ensure regular monitoring of the quality of water in the Danube basin and uses mainly the informations provided by the State Committee for Hydrometeorology and by Ministry of Health Protection of Ukraine. Local representatives of the Ministry for Environmental Protection and Nuclear Safety of Ukraine perform only random effluent sampling to check out the compliance with environmental regulations. Such verification envisages sampling 500 meters downstream the point, where effluents are released. It enables to determine “possible dissolution” of effluents, which is necessary to calculate content limitations. The inspection departments to the Ministry for Environmental Protection and Nuclear Safety of Ukraine perform analyses of water samples downstream releasing points to identify eventual infractions and to apply civil penalties.

The other agencies responsible for conducting the state water monitoring include the State Committee on Geology and Mineral Resources (SCGMR), the State Committee for Housing and Communal Services (SCHCS), their local authorities, as well as organizations that pertain to the regulative sphere of the above mentioned ministries and state agencies.

The National Space Agency of Ukraine (NSAU) provides the agencies conducting the state water monitoring with the available historical and up-to-date aero-cosmic information from the remote gauging of the territory of Ukraine.

The state water monitoring is conducted with the aim of ensuring collection, processing, storage, and analysis of the information on the condition of waters, prediction of its changes, and development of the recommendations for making scientifically substantiated decisions in the field of water usage and protection, and water resources restoration.

The state water monitoring is conducted in terms of water quantity and quality.

Subjects of the state water monitoring are as follows:

- surface waters;
- natural water bodies (lakes), water courses (rivers, streams);
- artificial water bodies (reservoirs, ponds), channels and other water bodies;
- groundwater and springs;
- internal sea waters and territorial sea; exclusive Ukrainian (marine) economic zone;
- sources of water pollution, including wastewater; accidental discharges of liquid products and wastes; products and material losses in a process of mineral resources extraction within aquifers of surface waters, internal sea waters, territorial sea waters and exclusive Ukrainian (marine) economic zone; as well as dumping of wastes, waters of surface drainage from the agricultural fields, filtration of pollutants from technological water bodies and reservoirs; and massive growth of the blue-and-green algae;
- release of harmful substances from sediments (secondary pollution), and other sources of pollution, which could be subject to observation.

The following water objects in Ukrainian surface should be monitored:

- water bodies, which are recipients for wastewater from large towns
- wastewater discharges from separate industrial facilities
- water area used for fishing

- transboundary water bodies near the sites of the border crossing
- mouths of the rivers

Ukrainian State monitoring system in Danube basin includes observations on the rivers, 15 reserves, 7 lakes, 1 channel. Observations are performed at 54 monitoring stations including 30 stations for quality control.

All monitoring sites are subdivided as monitoring stations of different category (1, 2, 3, 4), each of them presents own monitoring programme dealing with importance of the station’s location.

3. Actual and Planned Projects and Policy Measures for Reduction of Water Pollution

3.1. Reduction of Water Pollution from Municipalities

The municipal wastewater discharges into rivers have major impact on river water quality in term of nutrient loads and bacteriological pollution. Ukrainian municipal wastewater treatment systems have very special feature comparing to the many European countries: many industrial enterprises directly discharge their wastewater into municipal sewer system. That is why municipal wastewater discharges potentially are the source of serious pollution source with heavy metals and persistent organic micropollutants.

3.2. Reduction of Water Pollution from Agriculture

General remarks

Reduction of agricultural pollution will require careful feasibility studies with consideration of inevitable economic growth in the Danube River basin. Current economic crisis and transition to market economy and private ownership dramatically changed the sectoral industrial and agricultural structures. As has been mentioned in Part C the overall fertilizer use, pesticide application decreased sometimes 10 fold comparing with the 80-s. The major reasons for these reductions are high prices for these goods and low pollution income.

None of the projects on reduction of agricultural pollution has been proposed by regional administrations. Nevertheless pilot projects for assessment of overall agricultural pollution in the Odessa region at the territory along the river Danube with following expanding of activities throughout whole Danube River basin are considered as a useful ones. The problem will be among the most urgent because existing statistical data are not valid. Cost estimates for the project is USD 500.000.

All measures and projects are presented as a state or regions programmes with the figures showing the total funds for the region or state. Taking into account that the regions' territory includes different river basins it is impossible for the time being to extract the figures especially for the Danube basin.

All data available on the state level (Ministries and State Agencies) are integrated, which presents the necessary funds for the measures but not for the projects. The information about the projects is available only on the local level.

3.2.1. Prevention of Pollution from Agricultural Point Sources

Information is not available, see General remarks.

3.2.2. Prevention of Pollution from Agricultural Non-Point Sources

Information is not available, see General remarks.

3.2.3. Reduction of Water Pollution through Improved Land Management

Information is not available, see General remarks.

Table 3.1. Summary of recommended projects for municipal hot spots

Hot Spot Name, River and location (distance from mouth)	Parameters & Values which Define the Problem	Ranking of the Problem	Name & Type of Project (Structural or Non-structural)	Project Strategy & Targets	Parameters & Values which Define Project Benefits	Project Beneficiaries
Kolomyia WWTP, Prut, 867 km	Insufficient Current Capacity of Municipal WWTP Versus to Real Wastewater Load, Capacity:56,3 TPE, Load: 71,3 TPE, Total BOD: 149,0 t. per year, COD-223,0 t per year, N-106,0 t per year, P-34,5 t per year Chemical and Biological treatment-Total discharge 6.935 Th. m^3 per year	Low priority	Structural Project No 18, Structural Project No 14; Structural project No 15 WWTP	Reconstruction of existing & Construction of new WWT facilities (secondary treatment)	Final capacity will be increased to 168 TPE	Municipality of Kolomiya Town, Ivano-Frankivska oblast
Mukachevo WWPT, Latorytsia, 106 km	Insufficient Current Capacity of Municipal WWTP Versus to Real Wastewater Load, Capacity: 122 TPE, Load: 86,6 TPE, Total BOD: 165,1 t. per year, COD 206,4 t per year, N 95,1 t per year, P 48,9 t per year Chemical and Biological treatment Total discharge 8.424 Th. m^3 per year	Medium priority	Structural project No 20; WWTP; SEWAGE;	Reconstruction of existing & Construction of new WWT facilities (secondary treatment) upgrading sewage system	Final capacity will be increased to 165 TPE	Municipality of Mukachevo Town, Improvement of transboundary situation, Zhakarpatska oblast
Uzhgorod WWTP, Uzh, 33 km	Insufficient Current Capacity of Municipal WWTP Versus to Real Wastewater Load Capacity: 187,5TPE, Load: 297 TPE, Total BOD: 646 t. per year, COD 807,5 t per year, N 326,7 t per year, P 130,1 t per year Chemical and Biological treatment Total discharge 28.908 Th. m^3 per year	High priority	Structural project No 5, WWTP	Reconstruction of existing & Construction of new WWT facilities (secondary treatment)	Final capacity will be increased to 281 TPE	Municipality of Uzhgorod Town, Improvement of transboundary situation, Zhakarpatska oblast

Table 3.1. continued

Hot Spot Name, River and location (distance from mouth)	Parameters & Values which Define the Problem	Ranking of the Problem	Name & Type of Project (Structural or Non-structural)	Project Strategy & Targets	Parameters & Values which Define Project Benefits	Project Beneficiaries
Chernivtsi WWTP, Prut, 772 km	Insufficient Current Capacity of Municipal WWTP Versus to Real Waste Water Load Capacity:- 285 TPE, Load: 343 TPE, Total BOD: 467,2 t. per year COD 966 t per year, N 145,1 t per year, P 18,3 t per year Chemical and Biological treatment Total discharge 33.387,9 Th. m^3 per year	High priority	Structuralproject No16, WWTP; Structural Project No17, Sewerage; Structural Project No 18 Waste Structural Project No9 Sewerage Structural Project No 15	Reconstruction of existing & Construction of new WWT facilities (secondary treatment)	Final capacity will be increased to 450 TPE	Municipality of Chernivtsi Town, Improvement of transboundary situation, Chernivetska oblast.

3.2.4. Measures to Optimize the Use and Protection of Water by the Agriculture

The environmental and water consumption crisis in Ukraine, which tends to exacerbate, calls for an environmentalization of the Ukrainian agrarian manufacturing, necessitates such logistic for the agricultural industry that would be compatible with the biosphere. The goal to protect water resources can be achieved through, first of all, the cessation of crude and unsatisfactorily treated sewage water to be released into bodies of water; the prevention of quantitative and qualitative exhaustion and degradation of water sources; putting in place and running a rational system for recovery of water resources; an economical consumption of water by all manufacturing sites and agricultural utilities.

Agricultural engineering measures can, if duly implemented, substantially (sometimes by 30-40%) scale down content of pesticides, fertilizers, by-products and substances in the surface flow coming from arable land. This is effected by a number of engineering arrangements having a protective (nature-protective) character: plugging and cultivation of soils against slopes (hills), plugging, that retains a cut-off layer of land, retention of snow and thawing water, stripelike positioning of agricultural plants to be cultivated, terracing of slopes (hills) as well as use of granulated fertilizers, their local in-bring, environmentally justified and sound norms and techniques to utilize pesticides etc.

The development and implementation of a system for science-based charges for the pollution of bodies of water by sewage water generated by cattle-breeding utilities, by crude drainage water of reclamation and hydration origin, for non-compliance with good practices for storage and utilization of fertilizers and chemistry-based techniques to protect plants, for the pollution of the environment, including bodies of water, by similar substances is of great relevance. The environment security considerations should be carefully taken into account under the manufacturing of pesticides and fertilizers as well as while conceiving techniques for their bringing-in in soils, designing and constructing reclamation and water management systems, erecting cattle-breeding complexes etc. This implies to manufacture the fertilizers with programmable release of nutritive substances, to upgrade the efficiency of use of nutritive substances contained in nitric and potassium fertilizers - up to 70-80%, in phosphorus fertilizers - up to 50-60% and more. At the same time one should essentially increase the concentration of nutritive substances in fertilizers, scale down drastically the share of harmful and waste admixtures, come up as fast as possible with the production of compound and chroline-free fertilizers, with the supply of new up-to-date technical tools to bring fertilizers into soils to agricultural utilities. A considerable scaling-down of chemicals' wash-away rate can be ensured through upgrading of design of reclamation systems and watering equipment, thus enabling the economical consumption of water.

As far as pesticides are concerned the bottom-line resides in changing their composition, chemical and physical properties in a way that the substances and combinations, which the pesticides contain, would disintegrate into neutral and safe substances in the presence of water and microorganisms. Along with scaling down biological activity of pesticides and their concentration with a view to inhibit their deleterious impact on the natural environment and bodies of water, the biological techniques to fight diseases are to be used broader.

The formation of erosion stable (robust) agricultural landscapes, the implementation of environmentally safe crop-growing systems, the creation of efficient water protective areas along all rivers, their tributes, and in the areas, which are adjacent to lakes, water reservoirs and other bodies of water are important measures to protect water. The width of a water protection area has to be 300-400 m, sometimes even 500 m, the width of waterside streaks should be not less than 40 and up to 100 m, i.e. 1/5 part of the water protective area depending on the length of a river and its abundance. Utilization of fertilizers and pesticide, releases of crude sewage water generated by cattle-breeding complexes and farms, sprinkling crop with spent water are prohibited on this territory.

The construction of new or enlargement of operational cattle-breeding complexes and farms, of facilities to store fertilizers and pesticides, the formation of pastures for animals, the commissioning of parking areas for cars and agricultural conveyance means are not allowed in the water protective zones. The conduct of activity related to the regulation of flow the construction of water intake facilities is permitted only following a specific concentration process, i.e. concurrence by the Ministry for Fishery and the State Committee of Ukraine for water management.

Waterside streaks should be obligatorily planted by trees and bushes being natural regulators of flow. Waterside planting prevents the progress of erosion processes and captures pollutants well.

Within limits of water protective zones and especially of the shore sides (streaks) one should not plough and pasture animals. If the water protective area belongs to a territory with an average economic activity then the watersides must be a territory, where any type of commercial activity is strictly regulated.

Within limits of water protective zones of rivers, lakes, water reservoirs and artificial lakes a complex of administrative territorial forest reclamation, antierrosive, hydroengineering and other arrangements aimed at upgrading the sanitary-hygienic and environmental state of both a water body itself and its waterside, at enhancing the quality of water resources and preserving self-cleaning and recovery functions of water sources should be implemented. Regretfully, a considerable part of rivers, lakes, and other bodies of water have no reliable water protective zones in accordance with science-based recommendations; on the country, even where such zones are available, the requirements regarding control sand limitations of intensive agricultural activities are not always strictly followed, the required arrangements to decrease the migration of pollutants to bodies of water are not made in full scope. This regards specifically small and medium rivers. By withdrawing water and polluting these rivers, society caused irreversible damages to main waterways since performance of small and medium ones.

The limits of field often approach the banks of rivers, lakes, water reservoirs, which is the principal cause for their silting. A big deal of agricultural utilities, farms etc. is located too close to water in some places of the Ukrainian part of the Danube basin. The same is characteristic to cattle-breeding farms and complexes. This causes much damages to water resources since the overloaded out-of-date, and in some cases even primitive muck (manure) storage areas belonging to farms and complexes, make poisonous leaks flow to rivers and lakes. The issue of introducing clean cattle-breeding complexes and farms has been successfully resolved neither by science, nor by practice.

A considerable number of agricultural enterprises and utilities does not comply with the relevant environmental requirements while conducting commercial activities in the water protective zones, does not pay due attention to plant and maintain trees and other facilities, which are located within limits of the water protective zones. As a result the polluted waste of agricultural origin enters the hydrological net with no obstacles.

Thus, the listed below arrangement foster drastic improvements of water resources under intensive agricultural activity:

- introduction of and compliance with the norms and techniques to bring in fertilizers with due respect to soil, climate and geographical peculiarity of each crop-growing region, to the agricultural hardware available etc.;
- bringing in of fertilizers mainly in granulated form as well as locally;
- implementation of strict control over compliance with the rules to utilize fertilizers and other chemicals at any agricultural utility;
- the prevention of storing fertilizers and other chemicals for a long period of time with no utilization in cultivated fields and land;
- the arrangement of correspondingly equipped sites for intermediate stockade of fertilizers and pesticides in fields in order to prevent their inadvertent ingress into the environment;

- compliance with clearly established norms and practices with requirements relating to utilization of pesticides, herbicides and fertilizers set forth by sanitary and environmental surveillance authorities;
- restricted utilization and mandatory sanitary and environmental control over upscale, medium- and low toxic chemicals having no cumulative purposes in crop-growing areas that are adjacent to the water protective zones;
- prevention in all case of rinsing or washing of pesticide casks in bodies of water of releases of water polluted by chemicals and of rests of chemicals into them;
- broad implementation of specific agricultural engineering arrangement in order to reduce the volumes of fertilizers and other chemicals being washed away and released into bodies of water;
- environmental education of agricultural workers, comprehensive environmental awareness at each agricultural utility and enterprise, farm and in the country in general.

It is necessary to place particular emphasis on the issue of treating and making non-poisonous sewage water and domestic effluents generated by rural communities, by agricultural industrial utilities, by cattle-breeding complexes and farms, which consume constantly growing volumes of water. Although these utilities are spread over large territories, still their effluents pollute and exert negative effluence on the quality of surface water sources. By the way, these are the relatively small agricultural industrial utilities, in particular of food industry, located in the county and in principal community centers that often cause the most damages to rivers, lakes, and water reservoirs. As opposed to big enterprises, which have in place reliable water recycling systems and operating powerful clean-up facilities, the smaller ones do not have them in operation as a rule. That is why all their liquid effluents featuring a complete set of toxic and hazardous substances enter the bodies of water.

The principal neutralization techniques are biological clean-up facilities, filtration fields and crop-growing reclaimed fields. In particular, one should operate so called small clean-up facilities - biological filters, oxidation channels, artificial lakes for biological clean-up, which are able to process 500-700 m^3 per day and manifest not only operational conveniences but also high quality of operation.

While commissioning processing plants, utilities and enterprises that serve the agricultural sector of economics in the country, one should obligatorily envisage clean-up facilities, sewage water recycling systems and non-sewage water generating water supply systems. The treatment of sewage water, generated by the food industry utilities can efficiently take place immediately in irritable areas taking into account soil, hydraulic and geological conditions, the state of effluents to process, peculiarities of water balance and of irrigation along the seasons. Recently the waste generated by cattle breeding has been utilized as fertilizers and small farms have not been equipped with clean-up facilities and sewage. This practices cause presently enormous pollution volumes; sometime these are commensurate with the volumes of sewage water generated by towns and cities. Besides, the sewage water generated by cattle-breeding complexes and farms contain 2,5 times more biological hazardous substances than urban domestic waste. Subsequently, such utilities should obligatory have in place efficient clean-up facilities.

The techniques to treat and render harmless the sewage water generated by similar utilities depend on the manufacturing ways and the conditions of the environment. If the areas is rich in agrarian lands where fodder plant are cultivated or in forest the sewage water can be utilized for reclamation or soil fertilization purposes.

Each cattle-breeding complex and big purposive farm must have in operation up-to-date sewage water networks and clean-up facilities. They must apply:

- complete biological sewage water treatment in accordance with a specified scheme;
- division of waste by liquid and solid fraction for further use of water for watering purposes and of solid sediments for fertilizing ones;
- composting of effluents with peat particles (crumbs) and with organic crop-growing waste in specific receptacles followed by the utilization of the obtained compost as a fertilizer.

Table 4.2. Summary of recommended projects for agricultural hot spots

Hot Spot Name, River & Location (distance from mouth)	Parameters & Values which Define the Problem	Ranking of the Problem	Name & Type of Project (Structural or Non - structural)	Project Strategy & Targets	Parameters & Values which Define Project Benefits	Project Beneficiaries
Animal farming in Kylia Region	Includes two low priority hot sports and issues of introduction ecologically sustainable agricultural practices in animal farming pollution inventory, feasibility study	low priority	non-structural project No21	To support agricultural reforms and to prevent the future ecological problem from unsustainable animal farming	upgrading existing animal farms, farmers training, establishing the training center for farmers in the region	District authorities and farmers of the Kiliya region
	Kylia Collective Farm “Put Lenina”: Total BOD:no data Phenols: no data Total discharge: 25,71 Th. m^3 per year Lack of sewage treatment; possible pollution of ground water with direct impact on human health	low priority	non-structural project No 21	strategy for environmentally sustainable land use; introduction of ecologically sound agricultural practices ; enforcement of environmental legislation	State of ground water quality and surface water; flood prevention	Ministry for Environmental Protection and Nuclear Safety
	Lisky Collective Farm “Pogranichnik”, Kylia District: Total BOD: no data Phenols: no data Total discharge: 20 Th. m^3 per year Lack of sewage treatment; possible pollution of ground water with direct impact on human health	low priority	Non-structural Project No 21	strategy for environmentally sustainable land use; introduction of ecologically sound agricultural practices; enforcement of environmental legislation		
Pollution Reduction from the diffuse sources: a composite project	Danube (Vylkovo) and Tizsa river basins flood prevention: catastrophic floods from inappropriate land use and unsustainable agricultural practices and deforestation: threats of epidemiological pollution, nutrients and pesticide pollution	High priority special problem	Structural projects No 1; No 2; No 6; No 12	pollution prevention, reduction of economic losses; population safety	upgrading bank protection constructions; creation of early warning system	water management authorities of the Tisza river basin and Vylkovo

3.3. Reduction of Water Pollution from Industries

Major successes in industrial pollution reduction will be achieved through the managerial measures and enforcement of existing environmental legislation and regulatory measures. Structural changes in industrial sector during transition to market economy are difficult to predict at present time. Under existing legislation and regulations industrial enterprises with a significant environmental impact must perform self-control of discharged pollutants within the regulatory procedure. From this point of view for enforcement of legislation additional support will be necessary for capacity building of the regional state inspections of the Danube River basin.

There were several industrial enterprises using galvanic technologies in their technological processes. At present their production is not clear and additional money should be allocated to the Ukrainian part of the Danube River basin for the inventory of currently operating industrial enterprises and their technological wastes and tailings.

The biggest Ukrainian ports at the river Danube are Izmail River port and Ust-Dunaisk marine port , which do not operate at their full capacity. The measures to prevent oil and grease pollution from these enterprises will be needed as soon as they begin to recover. Nevertheless oil pollution may occur because of accidents with crude oil pipelines of Zakarpattia region as well as from the poorly maintained small size boats. This type of pollution will require additional study as well.

Table 3.3. Summary of recommended projects for industrial hot spots

Hot Spot Name, River & Location (distance from mouth)	Parameters & Values which Define the Problem	Ranking of the Problem	Name & Type of Project (Structural or Non – structural)	Project Strategy & Targets	Parameters & Values which Define Project Benefits	Project Beneficiaries
Reconstruction of timber processing industry in upper Tizsa in Ukraine: a composite project	Includes reconstruction of waste water treatment facilities of Velyky Bychkiv, Teresva timber processing plant and Rakhiv cardboard factory; consists of projects 3, 4, and 22	medium	Structural Project No consists of No3 No4, and 22	feasibility study, reconstruction and construction of waste water treatment facilities, improvement of technological processes	pollution reduction from timber processing industry in the Tizsa River basin in Ukraine	
Rakhiv Cardboard Factory, Tisza river	Total BOD: 39 t/y, phenols no official discharge data, total discharge: 792.000 m^3/day	Medium priority	Structural Project No 22	Reconstruction of existing & Construction of new WWT facilities and accumulation pounds, improvement of the technology processes	Reduction of the Tissa river pollution with phenols, oil products and especially BOD organic.	Rakhiv Cardboard Factory, Municipality of Rakhiv town & Zhakarpatska oblast
Velikiy Bichkiv Timber processing Plant, Tizsa River	Outdated WWTP, pollution with phenols and chlorinated organic compounds.	Medium priority	Structural Project No 3	Construction of new WWT facilities (secondary chemical treatment)	Developing recreational and sport fishing uses & Elimination of transboundary affect.	Velikiy Bichkiv Timber processing Plant & Municipality of Velikiy Bichkiv town & Zhakarpatska oblast
Teresva Timber processing Plant, Tizsa river	Total BOD: 23 t/y, Total discharge : 839.900 m^3/day, pollution with phenols and oil products	Medium priority	Structural Project No4	Reconstruction of existing & Construction of new WWT facilities (secondary treatment)	Developing recreational use & Elimination of regional and possible transboundary affect	Improvement of regional and transboundary situation, Zhakarpatska oblast
Izmail Cardboard Plant	Insufficient input capacity of industrial WWTP with increased producing capacity.	Low priority	Structural Project No 11, WWTP	Reconstruction of existing WWT Improving of the existing technological process	Existing capacity will be use more rational	Municipality of Izmail Town, Improvement of transboundary affect on Black Sea Odesska oblast.

3.4. Reduction of Water Pollution from Dump Sites

At present time 40 mln. m^3 of sludge are produced from wastewater treatment plants. Sludge should be stored on the special sludge landfields. After disinfection measures and environmental impact assessment sludge can be used as fertilizers (in reality about 5% or 2 mln. m^3 is only utilized). There is no data at present time on dumpsites in Danube basin. There are not any facilities in the region for preparation of wastewater treatment sludge for utilization. There is not any incineration facilities or other facilities for solid waste disposal in the region. This is one of the most serious problems of the region because of the landfields and dumpsites are serious source of diffuse pollution in the region. In many cases they severely affect to ground water quality as for example in Bolgrad district of Odessa region as was reported by Odessa State Ecological Inspection. The future activity for pollution reduction from these pollution sources must be directed on inventory of pollution sources, assessment of the size of diffuse pollution and introduction of ecologically friendly technology for the solid waste processing and disposal.

Ukraine will need external financial support to carry out the needed assessment and introduction of new technology in the field of solid waste disposal.

3.5. Special Policy Measures

Economic Regulatory Tools for Water Resources Rational Use, Protection, and Restoration currently are under development in Ukraine. Ukraine introduces payments for natural resources use and fines for environmental pollution based on the principle “polluters pay” and allocation of these revenues for the environmental protection, conservation and restoration measures. Ukraine introduced the payment for special water use, which implies differentiation of water users. Ukraine regulates water uses through issuing permits and licensing.

3.5.1. Organizational-Economic Measures, Which Provide Water Resources Rational Use, Protection, and Restoration

Organizational-economic measures, which provide water resources rational use, protection, and restoration envisage:

1. issuing permits for special water use;
2. establishment of norms and amounts of payments for water extraction and polluting substances discharge;
3. establishing norms and amounts of payments for water use in hydropower generation and water transportation;
4. granting tax, credit and other privileges to water users if they implement low-waste, waste-free, energy- and resource-saving technologies, perform other measures in compliance with legislation, that reduce negative effect on waters;
5. compensation of damage for water bodies resulting from violation of legislation, according to the established procedure.

3.5.2. Payments for Special Water Use

Payments for special water use are established in order to provide water resources rational use, protection, and restoration, and include payments for water extraction from water body and polluting substances discharge in it.

Amounts of payments for water extraction from water body is established on a basis of payment norms, actual volumes of water extraction and established water extraction limits.

Amounts of payments for polluting substances discharge is established on a basis of payment norms, actual volume of discharge and established discharge limits.

Payment norms for special water use and procedure for collecting these payments are established by the Cabinet of Ministers of Ukraine.

3.5.3. Payments for Water Use in Hydro-Power Generation and Water Transportation

Enterprises, institutions, and organizations engaged in hydro-power generation and water transportation are obliged to pay for necessary services of water resources basin management, and for accomplishment of measures of prevention and elimination of consequences of adverse effect of waters (bank protection, protection of territories from being wet).

Payment norms for water use in hydropower generation and water transportation, as well as procedure for collecting these payments are established by the Cabinet of Ministers of Ukraine.

3.5.4. Distribution of Payments for Special Water Use and for Water Use in Hydro-Power Generation and Water Transportation

Payments for water extraction from water bodies of national significance are transacted to the National Budget of Ukraine by 80 %, while 20 % of them are transacted to the budget of the Autonomous Republic of Crimea and oblast budgets.

Payments for water use in hydropower generation and water transportation are transacted to the National Budget of Ukraine by 100 %.

Payments for water extraction from water bodies of local significance are totally transacted to the local budgets of the relevant Radas of people's deputies.

Distribution and procedure for using payments for polluting substances discharge into water body and over-limit water extraction, as well as payments, which compensate damages caused to water bodies, are determined by the Law of Ukraine "On Environmental Protection".

All mentioned payments are directed towards accomplishment of measures on water resources protection and restoration and keeping water bodies in due state, as well as on execution of work to prevent adverse effect of waters and to eliminate its consequences.

There are several documents in Ukraine dealing with the monitoring, control etc.:

1. On Approval of Regulation for Determination of Sizes and Boundaries of the Water Protection Areas and Regime of Economic Activity within These Areas
2. On Approval of the Guidelines for Execution of the State Ecological Examination
3. On the List of Sections of the Bodies of Water Used
4. For Commercial Fishing (Parts of Them)
5. On Approval of Regulation on Protection of Internal Sea Waters and Territorial Sea from Pollution and Littering
6. On Approval of Regulation on Reimbursement of Losses of Water Users, Resulting from Cessation of Right or Changes in Conditions of the Special Water Use
7. On Approval of Regulation on Conducting State Water Monitoring

8. Regarding Regulation on Development and Approval of Norms of Maximum Permissible Discharges of Pollutants, and an Inventory of Pollutants, Whose Discharge is Subject to Regulation
9. On Approval of Regulation on Water Fund Lands Use

There are not facilities on phosphate containing detergents in washing powder investigation.

There are no other special policy measures.

4. Expected Effects of Current and Planned Projects and Policy Measures

4.1. Redaction of Nutrient Emissions

Reduction of nutrients discharges is identified only for municipal pollution sources, which are presented in Table:

Table 4.1. Reduction of nutrients discharges from municipal pollution sources

Site, sampling location	River, basin	Waste water discharge (Tm^3/a)	N t/y	P t/y
Chernivtsi	Prut	33.397,90	145,10	18,30
Izmail	Danube	6.800,00	213,40	37,50
Kolomiya	Prut	6.935,00	106,00	34,50
Mukachevo	Latoritsa	8.424,00	95,10	48,85
Uzhgorod	Uzh	28.908,00	326,70	130,10

4.2. Hazardous Substances

Table 4.2. The sources of the hazardous substances

Name of the plant/location	River/main catchment area	Oil prod.	Phenols
Cardboard factory, Rachiv	Tissa	*	*
Timber processing plant, V.Bichkov	Tissa	*	0,002
Timber processing plant, Teresva	Tissa	*	*
Cardboard - Paper factory, Izmail	Danube	0,37	*

4.3. Microbiological Contamination

There are no data on microbiological pollution in wastewater. Only available data are on hygienic water quality.

4.4. Adverse Environmental Effects

Mitigation of existing adverse environmental impacts and planned measures for their reduction that imply the management policy refers mainly to improvement of municipal wastewater treatment facilities operation, construction or planning of industrial enterprises for chemical wastes processing with upgrading of technological processes and introduction of best available practices for agricultural land planning

The transboundary impact from pollution may occur: from oil pollution; nutrient, heavy metals and bacteriological pollution including pathogenic bacteria.

The high level of nutrient affects the ecosystem and water quality of rivers causing alga blooming, reduction of biodiversity. The poor water quality due to bacteriological pollution adversely affects human health and recreational resources and imposes the epidemiological threat.

Toxic industrial pollutants induce adverse mutagenic changes in human and aquatic life, decrease reproduction of fish stocks, cause malformations of infants and complications during pregnancy of women, impact the biodiversity and abundance of biological species.

The inappropriate agricultural practices and land mismanagement induce land erosion and following silting of rivers. The deforestation especially in upper reaches of the Danube increases diffuse pollution and creates the permanent threat of catastrophic flooding.

1. High priority tasks
   mitigation of environmental impact; improvement of recreational and other functions of existing water bodies at the territories nearby Uzhgorod, Velyky Bychkiv and Teresva
2. Medium priority tasks
   Chernivtsi, Izamail, Kolomyia, Rakhiv
3. Ranking of priority investments are carried out in correspondence with ranking of transboundary impact assessment on water quality in the Danube River basin.

Description of transboundary impact and trends in water quality are given in Chapter “Water Quality”.

Assessment of significant transboundary impact is presented in “Updating Hot Spots” and “Ranking Hot Spots” in Chapter “Water Quality”.

5. Cost Estimation of Programmes and Projects

Total cost estimates of existing and planned programmes and projects in the Danube River basin are 368,64 mln. HRV or $ 184.300.000. This assessment is very rough and does not reflect all needed measures for pollution reduction. Measures included in the study are the measures included in the "State Programme of Drinking Water Supply and Sewer Systems of the Settlements of Ukraine" and "The Integrated Programme of Flood Prevention". For implementation of "State Programme of Drinking Water Supply and Sewer Systems of the Settlements of Ukraine" it is foreseen to allocate money from regional and local budgets. Nevertheless due to on-going economic crisis in Ukraine money for needed measures are not allocated at all even for already started projects. It means that the implementation of most of proposed projects is problematic. The "The Integrated Programme of Flood Prevention" is in the similar situation and is funded only in case of serious accident, flood or natural disaster. Even in those cases funding is not sufficient and does not exceeds 10-20% of needed funding.

Assessment of funding needed for pollution reduction from agricultural sources, forests and other issues related with diffuse pollution cannot be currently done due to lack of reliable data. It is necessary to raise funding for inventory of diffuse pollution sources and development strategy and measures.

Thus, existing projects and programmes can be considered as planned ones.

Cost of actual projects and programmes is 103,48 mln. HRV or $51.740.000.

Cost of planned measures, projects and programmes is estimated is 265,158 mln. HRV or $132.600.000.

Distribution of funding between different financial organization including international funding is presented in the Table 5.1.

The high priority tasks in the Danube River basin are construction and reconstruction of municipal wastewater treatment facilities and wastewater treatment facilities of timber processing and paper factories in Zakarpattia region.

To upgrade and modernize the sewer and wastewater treatment system in the Danube River basin it is necessary to allocate system 182,226 mln. HRV including 34,8mln. HRV in Odessa region, Ivano-Frankivsk region - 19,86 mln. HRV, Chernivetsky - 18,1 mln. HRV, Transkarpatsky 109,47 mln. HRV. The high priority measures in municipal system require 134,6 mln. HRV including funding for sewer system and wastewater treatment facilities of Uzhgorod, Mukachevo in Zakarpattia region, Kolomyia in Ivano-Trankivsk region, Chernivtsi in Chernivtsi region and Izmail in Odessa region.

For industrial high priority "hot spots" of Teresva and Velyky Bychkiv timber processing factories it should be allocated 20 mln. HRV (or $5.000 each) of foreign investments.

Table 5.1. Cost of actual planned investment portfolio

				National Funding Sources											International Funding			Remarks
Type/name of Project or Programme	Total Capital Requirements		Funding Period	Equity	Envir. Fund	Water Manag Fund	Public Loans			Public Grants			Comm. Bank Loans	Others	Organisation	Grant	Loan	
							Central Budget	Reg. Budget	Local Budget	Central Budget	Reg Budget	Local Budget						
	(MNC)	(MUS$)		(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)		(MUS$)	(MUS$)	
Actual Investment Portfolio	103,48	51,74		1,35	38,76	-	2,041	0,04	-	-	0,01	0,9	-	-	-	16,0	14,19	
Planned Investment Portfolio	265,158	132,579		4,55	0,05	-	56,09	7,9	82,238	15,98	6,36	13,6	-	-	-	1,15	38,5	
Total sum	368,638	184,319		5,9	38,81	-	58,131	7,94	82,238	15,98	6,36	13,6	-	-	-	17,15	52,69	

6. Planning and Implementing Capacity

6.1. Planning Capacity

Compilation of actual planning capacities of authorities, institutions, companies etc. cannot be clearly described. Transition period in political, economic and managerial fields as well as structural changes in industry and agriculture impose many complications. The law on self governance delegates more rights to the local authorities but because of the very beginning of the process and not fully developed legislation roles of different stockholder and not clear. Economic restrictions do not allow to accelerate transition from planning to real implementation of projects and programmes.

At the moment capacity of Ukrainian institutions and engineering companies in project proposal, project design, business plan development, preparation of project documents is sufficient for preparation of bankable documents but cannot be funded properly without foreign assistance.

The foreign financial assistance in field of inventory of information needs, development of information exchange and databases as well as training in international accounting and other market economic issues is needed.

In Annexes of project proposals planning and engineering companies are indicated.

6.2. Implementing Capacities

6.2.1. Implementing Capacities for Structural Projects

On the whole the treatment plants for municipal and industrial wastewater can be constructed by Ukrainian companies if funding is sufficient.

The co-operation with foreign companies may be very useful but not always crucial.

Special machinery and pipes, corrosion resistant pumps, electric regulatory items, etc. can be procured from other countries when considering quality/costs benefits.

Some items are not currently produced in the country.

6.2.2. Implementing Capacity of Non-structural Project

In spite of heavy economic situation Ukraine has sufficient capacity for implementation of non-structural project. The overall coordinating activity of the Ministry of Environmental Protection is supplemented by the other governmental bodies involved in the environmental protection. Ukraine has strong academic institutes under the umbrella of the National Academy of Sciences to implement scientific component of these project. The complementary significant activities of non-structural projects may be implemented by sector institutes for applied research. Non-structural projects may be supported and implemented to some extent by joint stock companies, private research, consulting, business and other companies. The non-governmental organizations active in the Danube River basin will ensure wide involvement of public and students in implementation of non-structural projects.

For those projects that include inventories, surveys, research or development of regulatory norms and standards, as well as NGO development the financial support is needed from international co-operation.

Annexes

Table 1. Compilation of actual investment portfolio (Million US$)

No	Type/name of Project or Programme	Total Capital Requirements		Funding Period	National Funding Sources											International Funding			Remarks
					Equity	Envir. Fund	Water Manag Fund	Public Loans			Public Grants			Comm. Bank Loans	Others	Organisation	Grant	Loan	
								Central Budget	Reg. Budget	Local Budget	Central Budget	Reg Budget	Local Budget						
		(MNC)	(MUS$)		(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)		(MUS$)	(MUS$)	
TRANSCARPATHIAN REGION																			
1.	Complex longterm programme of antiflood measures in Ukraine (Zakarpatya region)	23,8	11,9	1998 1999 2000							2,9 9,5 11,4								
2.	Erection of the embankment on the Tysa River (Tyachiv)	1,74	0,87	1997-1999		0,36 0,2													
3.	Automatically controlled information measuring system for flood forecasting and Tysa River water resources management - 1st stage (ACIM - Tysa)	2,9	1,45	1997-1999		0,7 0,8												0,5	
	a) erection of center for information acquisition and processing with technological support in Uzhgorod																		
	b)equipment for information exchange																		
ODESSA REGION																			
1.	Complex longterm programme of antiflood measures in Ukraine (Odessa region)			1994-1998															
1.1.	Danube bank stabilization in emergency sites	0,094	0,047					0,094											
1.2.	Renewal of emergency parts of Danube check dams	0,121	0,06					0,121											

Table 1 continued

No	Type/name of Project or Programme	Total Capital Requirements		Funding Period	National Funding Sources											International Funding			Remarks
					Equity	Envir. Fund	Water Manag Fund	Public Loans			Public Grants			Comm. Bank Loans	Others	Organisation	Grant	Loan	
								Central Budget	Reg. Budget	Local Budget	Central Budget	Reg Budget	Local Budget						
		(MNC)	(MUS$)		(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)		(MUS$)	(MUS$)	
1.3.	Regulation of river and channel beds	0,146	0,073					0,146											
1.4.	Estimation of Danube river side flood areas	0,02	0,01					0,02											
1.5.	Cataloguing of water resource of the region	0,06	0,03					0,06											
CHERNIVTSI REGION																			
1.	Implementation of the extended project of sewer erection designated for Luzhany industrial area waste water discharge and implementation of waste water purification technology at Luzhany Pilot Distillery Plant.	2,7	1,35	1992-1999	1,27 0,08														
2.	Creation of the range for storage of solid waste products in Chernivtsi (2nd phase)	3,3	1,65	1996-2000									0,9					2,4	
IVANO-FRANKIVSK REGION																			
1	Complex longterm programme of antiflood measures in Ukraine (Ivano-Frankyvsk region) 1994-2000 p.																		
2.	Including Prut river	44,9	22,45	1998-2000															
				1998 1999 2000		0,62 3,10 5,18											- 4,0 6,0	- 3,0 5,0	

Table 1 continued

No	Type/name of Project or Programme	Total Capital Requirements		Funding Period	National Funding Sources											International Funding			Remarks
					Equity	Envir. Fund	Water Manag Fund	Public Loans			Public Grants			Comm. Bank Loans	Others	Organis ation	Grant	Loan	
								Central Budget	Reg. Budget	Local Budget	Central Budget	Reg Budget	Local Budget						
		(MNC)	(MUS$)		(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)		(MUS$)	(MUS$)	
3.	Prut's tributaries	22,0	11,0	1998-2000															
				1998 1999 2000		0,20 1,40 2,40											- 2,0 3,0	- 1,0 1,0	
4.	WWT facilities with the daily capacity of 100 m^3 (Vorokhta)	0.04	0.02	1998					0,03			0,01							
5.	WWT facilities with the daily capacity of 700 m^3 (Kuty)	1.6	0.8	1998-2000				0,06 1,0	0,01										

Table 2. Compilation of planned investment portfolio (Million US$)

No	Type/name of Project or Programme	Total Capital Requirements		Funding Period	National Funding Sources											International Funding			Remarks
					Equity	Envir. Fund	Water Manag Fund	Public Loans			Public Grants			Comm. Bank Loans	Others	Organisation	Grant	Loan	
								Central Budget	Reg. Budget	Local Budget	Central Budget	Reg Budget	Local Budget						
		(MNC)	(MUS$)		(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)		(MUS$)	(MUS$)	
TRANSCARPATHIAN REGION																			
1	Extension and reconstruction of Waste Water Treatment Facilities of Uzhgorod (3 turn)	50,0	25,0	1998-2005														25,0 $US	
2.	Reconstruction and repair of WWTP (Mukachevo)	0,297	0,148	1998-2000						0,05									
3.	Sewage channel on the Pryashivska Str., Mukachevo city	0,691	0,34	1998 1999 2000 2001 2002-2005						- 0,3 0,391									
4.	Second stage of the WWTP Mukachevo city	2,418	1,2	1998 1999 2000 2001 2002-2005						0,1 1,2 1,3 1,4 1,418									
5.	Reconstruction of the sewage system of the Khust city	0,091	0,045	1998 1999 2000						0,055 0,036									
6.	Pumping station of the industrial zone of the Khust city	0,141	0,07	1998						0,141									
7.	Second stage of the WWTP with 15000 cub.m/day capacity in the Khust city	8,343	4,17	1998 1999 2000 2001 2002-2005						- 0,21 0,3 0,62 7,213									

Table 2 continued

No	Type/name of Project or Programme	Total Capital Requirements		Funding Period	National Funding Sources											International Funding			Remarks
					Equity	Envir. Fund	Water Manag Fund	Public Loans			Public Grants			Comm. Bank Loans	Others	Organisation	Grant	Loan	
								Central Budget	Reg. Budget	Local Budget	Central Budget	Reg Budget	Local Budget						
		(MNC)	(MUS$)		(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)		(MUS$)	(MUS$)	
8.	Re construction and repair of WWTP (Svalyava)	0,051	0,025	1998-2000															
9.	Reconstruction and repair of WWTP (Beregovo)	0,058	0,029	1998-2000															
10.	Reconstruction and repair of WWTP (Vynogradiv)	0,120	0,06	1999						0,120									
11.	Reconstruction and repair of WWTP (Chop)	0,014	0,007	1998						0,014									
12.	Reconstruction and repair of WWTP (Tyachiv)	0,147	0,073	1999						0,147									
13.	Reconstruction and repair of WWTP (Irshava)	0,066	0,033	2000						0,066									
14.	Reconstruction and repair of WWTP (Berezny)	0,016	0,008	1999						0,016									
15.	Reconstruction and repair of WWTP (Mizhgir'ya)	0,006	0,003	1998-						0,002									
16.	Reconstruction and repair of WWTP (Volovets)	0,038	0,019	1999						0,038									
17.	The collecting channel in Olbrachta St.	0,713	0,356	1998-1999 2000 2001 2001-2005						- 0,2 0,22 0,293									
18.	Canalization pumping station (Svalyava)	0,59	0,3	1998-2005						0,05 0,32 0,22									
19.	The 2nd phase of treatment facilities with daily capacity of 7,000 m^3	3,893	1,95	1998-						0,21 0,66 3,023									

Table 2 continued

No	Type/name of Project or Programme	Total Capital Requirements		Funding Period	National Funding Sources											International Funding			Remarks
					Equity	Envir. Fund	Water Manag Fund	Public Loans			Public Grants			Comm. Bank Loans	Others	Organisation	Grant	Loan	
								Central Budget	Reg. Budget	Local Budget	Central Budget	Reg Budget	Local Budget						
		(MNC)	(MUS$)		(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)		(MUS$)	(MUS$)	
20.	Construction of the sewage system in the rural area of the region with total length 46,3 km	4,44	2,22	1998 1999 2000 2001 2002-2005						 0,384 0,672 1,373 2,016									
21.	Automatically controlled information measuring system for flood forecasting and Tysa River water resources management - 2nd stage (ACIM - Tysa).	1,8	-	1998 1999 2000															
22.	Complex utilization of timber with introduction of environmentally friendly technologies in Teresva Woodprocessing Enterprise.	10,0	5,0	1998-2000															
23.	Complex utilization of timber with introduction of environmentally friendly technologies in Velykobychkiv Wood Chemistry Enterprise	10,0	5,0	1998-2000															
24.	Construction of local area canalization networks in the villages of the region (the total length is 46.3 km	4,44	2,22	1998-2005						- 0,384 0,672 1,373 2,016									

Table 2 continued

No	Type/name of Project or Programme	Total Capital Requirements		Funding Period	National Funding Sources											International Funding			Remarks
					Equity	Envir. Fund	Water Manag Fund	Public Loans			Public Grants			Comm. Bank Loans	Others	Organisation	Grant	Loan	
								Central Budget	Reg. Budget	Local Budget	Central Budget	Reg Budget	Local Budget						
		(MNC)	(MUS$)		(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)		(MUS$)	(MUS$)	
ODESSA REGION																			
1.	Construction of Vilkovo Wastewater Treatment Facilities.	13,0	6,5	1999-2003				12,2				0,8							
2.	Extension of the Wastewater Treatment Facilities in Kiliya	9,0	4,5	1999-2002				8,4				0,6							
3.	Extension of the Wastewater Treatment Facilities in the Izmail Paper Factory (city WWTP)	7,2	3,6	1999-2003	3,0			3,2	0,8	0,2									
4.	Creation of the Wastewater Treatment Facilities in Reni.	5,6	2,8	1999 - 2003	1,5			3,0	0,9	0,2									
5.	Priority measures on protection against flooding and improvement of sanitary and epidemic situation in Vilkovo.	1,7	0,85	1998 2000				1,5	0,2										
6.	Kiliya protection against flooding (emergency measures).	3,8	1,9	1999-2005				3,0	0,6	0,2		3,4							
7.	Vilkovo city-channels erek reconstruction	4,8	2,4					4,0	0,4	0,4									
IVANO-FRANKIVSK REGION																			
1.	Extension and reconstruction of the Kolomiya city WWTP up to 45000cub.m/day capacity	16,6	8,8	1999-2003					5,0		6,6	3,3						2,0	
2.	Construction of the silt treatment facilities of the WWTP Kolomiya city	13,4	6,7	1999-2000				5,0			7,0	0,4						1,0	

Table 2 continued

No	Type/name of Project or Programme	Total Capital Requirements		Funding Period	National Funding Sources											International Funding			Remarks
					Equity	Envir. Fund	Water Manag Fund	Public Loans			Public Grants			Comm. Bank Loans	Others	Organisation	Grant	Loan	
								Central Budget	Reg. Budget	Local Budget	Central Budget	Reg Budget	Local Budget						
		(MNC)	(MUS$)		(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)		(MUS$)	(MUS$)	
3.	Additional engineering networks and facilities for the processing for the Kolomiya WWTP	9,3	4,6	1999 - 2000				5,0 4,3											
4.	Reconstruction of WWTP (Otynia)	0,4	0,2	1998-2000				0,4											
5.	Reconstruction of WWTP (Pechenizhyn)	0,2	0,1	2005-2008				0,18		0,02									
6.	Erection of WWTP(Hvizdtsi)	0,2	0,1	2004-2007				0,15		0,05									
7.	WWTP (Kovalivka), shareholder- Kovalivka	0,16	0,08	2005-2007				0,06		0,1									
8.	Measures on the elimination of the consequences of the flood on the drinking water facilities Knyazhdvir for Kolomiya city(river bank protection)	4,8	2,4	1999 2000				2,8 2,0											
9.	River bank protection on the Prut around the pumping station 2 Kolomiya city	0,9 0,4		1999 2000				0,4 0,5											
CHERNIVTSI REGION																			
1.	Sanation, design and demo reconstruction of water and canalization system of the old building- up part of Chernivtsi aimed at improvement of water supply and reduction of soil displacement risk	0,7	0,35	1999							0,23						0,25		

Table 2 continued

No	Type/name of Project or Programme	Total Capital Requirements		Funding Period	National Funding Sources											International Funding			Remarks
					Equity	Envir. Fund	Water Manag Fund	Public Loans			Public Grants			Comm. Bank Loans	Others	Organis ation	Grant	Loan	
								Central Budget	Reg. Budget	Local Budget	Central Budget	Reg Budget	Local Budget						
		(MNC)	(MUS$)		(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)		(MUS$)	(MUS$)	
2.	Erection of the 2nd branch of pressure collecting channel between main pumping station and city canalization treatment facilities (Magala)	7,6	3,8	1999-2001															
3.	Erection of sewage collecting channel between Storozhynetska Str. and the gallery situated in Chernyakhovskogo Str.	2,8	1,4	2000-2008									2,8						
4.	Erection of the gallery division between Gastello St. and active bore situated in Chernyakhovskogo St.	0,9	0,45	2000-2001									0,9						
5.	Expansion and reconstruction of Chernivtsi sewage system including increase of daily capacity up to 200,000 m^3	3,2	1,6	1998-2004							1,0	1,2	1,0						
6.	Design and erection of the 2nd branch of sewage pipe canal across the Prut River near main canalization pumping station	0,4	0,2	1998-2000									0,4						
7.	Reconstruction and repair of WWTP (Vyzhnytsya)	0,2	0,1	1998-2000	0,05	0,005					0,05	0,05							
8.	Reconstruction and repair of WWTP (Putyla)	0,1	0,05	1999-2001								0,1							
9.	Reconstruction and repair of WWTP ("Cheremsh" Sanatorium)	0,2	0,1	1999-2000								0,2							

Table 2 continued

No	Type/name of Project or Programme	Total Capital Requirements		Funding Period	National Funding Sources											International Funding			Remarks
					Equity	Envir. Fund	Water Manag Fund	Public Loans			Public Grants			Comm. Bank Loans	Others	Organisation	Grant	Loan	
								Central Budget	Reg. Budget	Local Budget	Central Budget	Reg Budget	Local Budget						
		(MNC)	(MUS$)		(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)	(MNC)		(MUS$)	(MUS$)	
10.	Construction of the polygon for storage of solid waste in Chernivtsi (2nd stage).																		
11.	Processing and raise of environmental safety of mud formations in "Vodokanal" enterprise (Chernivtsi)	2,0	1,0	1993-2000							1,1							0,5	

Bibliography

Water Code of Ukraine. Decree of the Supreme Soviet of Ukraine from 06.06.95.

The State of the Environment in Ukraine/Report on the Environment 1994

The State of the Environment in Ukraine/Report on the Environment 1995

The State of the Environment in Ukraine/Report on the Environment 1996

The State of the Environment in Ukraine/Report on the Environment 1997

Integrated Long Term Programme to Prevent Flooding in the Ukraine up to 2005.

The Programme of the Crisis Prevention Water Supply and Wastewater Treatment Facilities in Ukraine

The Programme of Development of Water Supply and Wastewater Treatment Facilities. Cabinet of Ministers Order of 17.11.97 N 1269

Water Recourses. - 1993 - 20, N4 - P.401-560.

Hydrobiology of the Danube and North-West Estuary Black Sea Cost /Timchenko V., Zyravleva L., Enaki I. - K.: Naukova Dumka, 1989. - 156p.

Hydrobiology Researches of Danube and Danubian Lakes/Editor-In-Chief S.Geinec, V.Romanenko. K.: Naukova Dumka, 1987. - 148p.

Hydrology of Danube/Almazov A., Bondar K.,Vagin N. - M.:Gidrometeoizdat, 1963. - 382p.

Hydroecology of Ukraine Region of Danube and Contiguous Lakes/ T.Kharchenko, V. Timchenko, A.Kovalchuk - K.: Naukova Dumka, 1993. - 328p.

Reference Book for Water Resorces, Yrozai, 1987.

The Procedure for the Exercise of State Monitoring of Water (Resolution No 815 of the Cabinet of Ministers of Ukraine of 20 July 1996)

Instructions on the Procedure of Elaboration and Approval of Maximum Admissible Discharge (MAD) of Substances into Water Objects with Recycled Waters (Order No 116 of the Ministry of Ecological Safety of 15 December 1994)