Tacis

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Support to the Implementation of Environmental Policies and NEAPs in the NIS

Task 10i: Sub-Project in Uzbekistan

Policy Package for Developing Incentives to Reduce Industrial Water Pollution

March 2003

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List of Acronyms and Abbreviations

BAT	Best Available Technique
BOD	Biochemical Oxygen Demand (note: although 'biological' is often used, it is in fact incorrect)
CEE	Central and Eastern Europe
COD	Chemical oxygen demand (potassium dichromate method)
DO	Dissolved Oxygen
EAP	Environmental Action Plan
EC	European Community
EEC	European Economic Community
EIFAC	European Inland Fisheries Advisory Commission
ELV	Emission Limit Value
EU	European Union
GDP	Gross Domestic Product
IPPC	Integrated Pollution Prevention and Control
MAC	Maximum Admissible Concentration
NEAP	National Environmental Action Plan
NGO	Non-governmental Organisation
NIS	New Independent States
OECD	Organisation for Economic Co-operation and Development
PSWC	Permits for Special Water Consumption
RU	Republic of Uzbekistan
SCNP	State Committee for Nature Protection
SSAS	Synthetic Surface Active Substances
TSS	Total suspended solids
UNECE	United Nations Economic Council for Europe
USD	United States Dollar
VOC	Volatile Organic Compound
WHO	World Health Organisation

Glossary

Drinking water:	Water supplied for human consumption
Khokimiyat	Regional subdivision in Uzbekistan also called *Oblast*
Raw water:	Water extracted from the environment before treatment
Suvakova:	Uzbek water services also known in Russia as *vodokanal*
Goskompriroda:	State Committee for Natural Resources

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1 BACKGROUND AND CONTEXT OF THE SUB-PROJECT

1.1 Presentation of the sub-project

The wider objective of the TACIS-NEAP2 project is to provide support to the implementation of environmental policies in NIS. The immediate objectives in Uzbekistan were:

- To undertake a sub-project covering one or some issues identified in the National Environmental Action Plan (NEAP)
- To provide methodological support on programming tools that can be used for the development of implementation programmes, with practical on-the-job training within the framework of existing implementation programmes development.
- To provide ad-hoc advice to the State Committee for Nature Protection (SCNP) and to the Ministry of Macroeconomics and Statistics on environmental policies implementation issues.

The major environmental policy documents recently developed in Uzbekistan are:

- The National Environmental Action Plan (NEAP-1998) and the decree № 469 dated 20 October 1999 to put it into execution
- The Strategy for Sustainable Development (1999)
- The State Programme for Environmental Protection and the Rational Use of Natural Resources for 1999-2005 (1999).
- The Environmental Performance Review (EPR) of Uzbekistan carried out by the UNECE in 2001.

These documents give a good overview of the main environmental problems faced by the country and raise, among other issues, the need for improving the water quality regulatory system in Uzbekistan. That is why the Project proposed to the State Committee for Nature Protection (SCNP) the implemention of recommendation 5.6 of the EPR through the Uzbek sub-project:

"The State Committee for Nature Protection should establish Maximum Allowable Concentration (MAC) for highly toxic substances such as mercury, cyanides and chromium, and strengthen the existing MAC in line with WHO and EU standards. The Ministry of Agriculture and Water Management (MAWM) should enforce these standards and implement the requirements of the NEAP for treatment of toxic wastewater discharged by industry".

After obtaining the agreement of the SCNP, the immediate objective of the country sub-project was designed to be supporting the development of a policy package aimed at providing increased incentives to industry to reduce water pollution. This first phase was designed to include the identification of the upstream linkages to environmental water quality standards, proposing reforms to the framework of these and deriving the primary data needed to link this into the next stage of the taxation reform. The Policy-package (presented in this report) was required to include the following elements:

- A set of key environmental water quality parameters for which it would be appropriate to set standards in order to provide increased incentives to reduce industrial pollution (Detailed in section 2).

- A revised set of standards for the environmental parameters that are identified, with an indication of the possible linkages between each standard and corresponding incentive mechanisms (Detailed in section 3).
- A set of clear and readily applicable methods for calculating discharge quality standards for direct industrial and municipal wastewater discharges, based upon the set of ambient environmental standards that is developed (Detailed in section 4).
- A set of clear and readily applicable criteria based upon effluent quality and municipal wastewater treatment considerations, for deciding how indirect industrial effluents should be handled (Detailed in section 5).
- A list of decisions to be taken by Uzbekistan and the SCNP and guidelines for completing the policy sub-package (Detailed in section 7).

A logical framework for Uzbekistan Sub-task 10i is attached as Annex 1.

1.2 Scope of Work & Methodology

In order to assess properly the status of Uzbekistan's existing system, it is first necessary define what a successful system of incentives would be expected to achieve. It is not sufficient to say that it must "protect the environment" because that means different things to different people and is open to a wide range of interpretation. A successful system will satisfy the following criteria:

- Flexibility. It will be sufficiently flexible to:
    - Enable the competent authorities to set, review and if appropriate revise its water use objectives as they relate to the quality of ambient surface water.
    - Enable more stringent criteria to be applied where there is a genuine need, and less stringent criteria to be applied where there is not such a need.
    - Provide incentives for industries to achieve an acceptable minimum level of pollution control, while at the same time conferring some tangible benefits for those industries that choose to invest their own money in any process that improves their environmental performance still further.
- Applicability. It will be applicable to all types of industry and all industrial discharges (whether direct or indirect) that are under State licensing.
- International acceptability. It will be consistent with international principles and standards. This is particularly important in the context of regulating discharges to trans-boundary rivers (e.g. the Syrdarya and Amudarya).
- Regulatory effectiveness. It will be effective at enabling the competent authorities to regulate potential and actual polluting discharges to surface water bodies and thereby enable them to fulfil their statutory obligations. Clearly, in order to do this successfully, the system must be able to recognise certain realities arising from the present state of the Uzbek economy.

It is now necessary to examine four quite separate issues:

- What exactly are Uzbekistan's present situation and system?

- What are the main reasons why the present system does not satisfy the criteria listed above?
- Which aspects of the present system need to be changed and to what extent, in order to produce a system that does satisfy the criteria?
- What other things need to be done in order that the system can function effectively?

The sub-project for Uzbekistan started from the existing situation with respect to environmental water quality standards and industrial incentive mechanisms. It followed a relatively straightforward sequence of logical stages, in which the sub-project team worked to assemble information, consulted with stakeholders and took stakeholders' views into account in finalising proposals.

In order to illustrate how certain aspects of our proposals might function in practice, it was proposed that our analysis and proposals should be examined using some data from a key industrial river basin. The Akhangaran basin was selected for this purpose. On the one hand, this enables local experts to relate the recommendations of the sub-project to a real situation. On the other hand, it provides the basis for pursuing the full implementation of the recommendations in the Akhangaran basin, if the Government of Uzbekistan so wishes.

1.3 Background

1.3.1 Legal context in the water and water quality sectors

The Government of the Republic of Uzbekistan (RU) gives great importance to the realization of system of state control over protection and rational use of water resources in the Republic of Uzbekistan. The principles governing protection of environment in the territory of the Republic are described in the detailed listed in Annex 2 and in the selected following legal documents:

Laws of the Republic of Uzbekistan:

- "Law on nature protection" 09.12.92 that sets up legal, economic and organizational ground for protection of environment as well as for use of natural resources, and allowed progress toward creation of a unified system of economic regulation of nature use.
- "Law on water and water use3 06.05.93
- "Law on protected areas, with amendments" 30.08.93

Decrees of the Government of the Republic of Uzbekistan:

- "Regulations on water protection areas of reservoirs and other water bodies, rivers and main canals and collector drains; on sources of drinking and communal water supply, for medical health and recreation purpose in the Republic of Uzbekistan" 07.04.92
- "On limited water consumption in the Republic of Uzbekistan" 03.08.93
- "On imposing the payment for over quota effluents of contaminating substances in the environment and allocation of wastes" 29.06.92
- «On action plan for the environment in the Republic of Uzbekistan in 1999-2000, 20.09.1999

Resolution No.1045 of the Council of Ministers of the USSR:

Resolution No.1045 of the Soviet Council of Ministers (15th September 1958) states that, «All water bodies and their tributaries which are being used or could be used for commercial fishing or are of importance to commercial fish reproduction are considered water bodies for fishery purposes». This Resolution was repealed by the former USSR in 1988. However, it is still applied in Uzbekistan by the SCNP as if the Resolution was still in force when in fact there is no legal requirement to do so. This imposes enormous burdens on the resources of the regulated community, because the requirements for fishery waters are more stringent than those for other uses. The list of regulated substances is extensive, comprising more than 1,000 substances.

Sewage discharge by water consumers to the surface streams and water bodies are regulated by the “Rules of surface water protection”.

1.3.2 Existing water quality management

According to the law of the Republic of Uzbekistan “on water and water use”, the State Committee for Nature Protection (SNCP) is a special authorized state body that exercises control over the quality of water resources using monitoring data of Glavhydromet and the State Committee of Geology. Regulations on SCNP were ratified by the parliamentary decree № 232-1 dated April 26, 1996.

The State Committee for Nature Protection:

- Organizes and exercises the monitoring and control of the effluents from industrial, non-industrial, the transport sectors and domestic discharges.
- Exercises control over the execution of measures by enterprises for reducing harmful substances in the effluents
- Implements monitoring of pollution sources and assesses their impact on water resources.
- Analyses the data collected by other monitoring bodies (Glavgidromet, State Geology Committee, enterprises, organizations etc.)
- Takes measures aimed at preventing or eliminating water pollution (water protection measures, penalties, production cut off of shops and enterprises).
- Issues monthly and annual information bulletins on the sources of contamination, their influence on the environment and the efficiency of purification plants.
- Issues Permits for Special Water Consumption (PSWC) and sewage discharge for Almost all enterprises and other organizations

The PSWC includes one document for water extraction and one for wastewater discharge only in case of existence of sewage discharged into water objects. PSWC also include a list of water protection activities that the enterprise must implement within the terms of the proposed schedule. Each PSWC is issued for a period of 3 to 5 years and is reconsidered in cases of expiration of its validity or changes of water consumption terms. Applications for PSWC receive comments from the territorial inspection of land and water control and are approved by the supervising deputy chairman of the SCNP.

There are neither common quality standards nor common methodology for calculating Emission Limit Value (ELV[1]) of enterprises. Enterprises work out themselves the ELV of polluting substances for every point of discharge. The worked out ELV standards are considered, approved and controlled by the bodies of SCNP. The Ministry of Health exercises observance and control over the bacteriological parameters in industrial, drinking and sewage waters.

At present time, one of the main directions of solving the problem of environment and rational use of natural resources in the transitional conditions to market economy is the use of economic methods of management of nature protection activity based on the principles of payment for nature use (see section 6).

1.3.3 Existing monitoring system for industrial pollution

Before 1995, there was a single state system of records concerning water consumption and water quality characteristics (the 2TP form from the former Soviet Union) based on the special format of State statistical reporting. At present reporting is transferred to the authorization departments of concerned ministries, and doesn't contain information on ecological indicators, such as the sewage flow, re-circulated water supply, capacities of purification plants, effluent water quality, location of sewage water releases etc.

The remaining monitoring of the release of sewage water is carried out mainly by industrial water consumers through their own laboratories. Nevertheless, there is no single form of making records on water consumption, statistic reports, collection and data analysis of water records. The sampling frequency for each of the designated parameters is determined in accordance with GOSSIAK (the State inspection body of analytical control). In some big enterprises, samples are carried out on a daily base and in other smaller enterprises, samples are carried out once every 10 days to a month. The quantity of designated parameters depends on the specific features of enterprises indexes, and ranges from 6 to 20.

Independent and regular control and monitoring of sources of contamination such as effluents of industrial, municipal, agricultural and other enterprises are also carried out by the GOSSIAK bodies of the State Committee for Nature Protection on the whole territory of the Republic of Uzbekistan. Controlled enterprises and priority contaminating substances are determined on a regional basis. Control over the sources of effluents from contaminating objects is exercised by 18 specialized inspections of from SCNP located in the following cities: Andijan, Ahangaran, Bekabad, Bukhara, Gulistan, Jizah, Karshi, Kokand, Navoi, Namangan, Nukus, Samarkand, Tashkent, Termez, Urgench, Ferghana, Chirchik and Yangiyul.

Inspection controls are planned and carried out according to the schedule approved by the decision of the Territorial Coordinating Council for Control. At the national level, even less numerous, the inspections are planned in the same way.

There is a gradation of enterprises subject to inspection depending on their manufacturing capacities, their impact on water resources and their operating stability. Surveillance of the execution of the nature protection measures mentioned in the licences has been planned as well. In that respect, non-observance of appropriate manufacturing technologies and wild polluted run off are often observed.

[1] дпс in Russian

The general list of water quality indexes to be controlled by GOSSIAK includes 56 indexes (cf. Annex 3). However, the quantity of indexes actually monitored by GOSSIAK ranges from 3 to 20, due to a lack of equipment and low skills of laboratory personnel. The quantity of monitored water quality parameters reduces from year to year. For example, in 1990, from 10 to 20 ingredients were measured for each sources of contamination; in 2000, this quantity was reduced to 2 to 10. In some regions the monitoring of sources of contamination for 2000 was not exercised (for example in the Andijan and Fergana regions) or was exercised only for 2 or 3 parameters. The main controlled indexes are: suspended particles, mineralisation, ammonium nitrogen, nitrate nitrogen, nitrite nitrogen, BOD and oil products. Sampling is carried out in the effluents of the enterprise and upstream and downstream of the discharge point (from 4 to 100 m, the distance being determined by the SCNP depending on the volume, sewage quality and stream contamination).

Recording of water resource consumption is carried out by the Ministry of Agriculture and Water Management. The quantity of water consumption for irrigation needs and conveyance of collector drainage water are recorded on an annual basis. Accounting and generalization of water consumption and sewage flow indexes by industrial sector is carried out only within the structure of different ministries (for example Ministry of chemical industry, Ministry of Mining industries etc.)

One of the obstacles to improving water quality in Uzbekistan is the lack of reliable monitoring data on water quality on ground and surface water quality as well as on the sources of contamination. This is certainly due to the lack of good quality equipment, irregularity of data collection and absence of standardised water sampling methods and data analysis and processing. The overall deficit of staff also decreases the quality of provided data.

Equipment and methods of analysing the contaminating ingredients that are used by the SNCP, Glavgidromet and the State Geological Committee do not meet the modern requirements. Lack of chemical reagents also causes difficulties (especially in the process of exercising control over the industrial discharges of arsenic, mercury, fluorine and cyanide).

In order to change the situation it is necessary to improve the ecological monitoring on the status of surface, underground, drinking and sewage water in the whole territory of Uzbekistan and Central Asia states and to unify the system of collecting, processing and transferring information.

2 SELECTION OF KEY WATER QUALITY PARAMETERS

The objectives of this chapter, which is based on sub-project Activity 10i(1), are as follows:

1. To analyse main water quality problems in rivers, particularly with regard to identification of the critical parameters (pollutants).
2. To analyse the main industrial discharges, particularly regarding the above-mentioned parameters.
3. To identify the main polluting industrial categories in Uzbekistan.
4. To determine the parameters that should be monitored in each category.

2.1 Main ambient water quality problems in Uzbekistan

2.1.1 General Overview of water quality problems in Uzbekistan

Any overview of water quality issues in Uzbekistan needs to start by analysing the reference points against which water quality is to be judged. Maximum Admissible Concentrations (MACs) in Uzbekistan are in some cases significantly more stringent numerically than those that apply in the European Union. (This difference is exacerbated by Uzbekistan's adherence to the "no risk" principle in setting MACs.) Consequently, it is not clear what is the significance, in environmental impact terms, of occasions when the concentration of a particular parameter might exceed a MAC that is unrealistically stringent: it may or may not be indicative of a problem.

This being said, all of the statements made in this general overview are based upon Uzbekistan's existing system of MACs. The figure 2.1 shows the different classes of water quality in the Republic of Uzbekistan (RU).

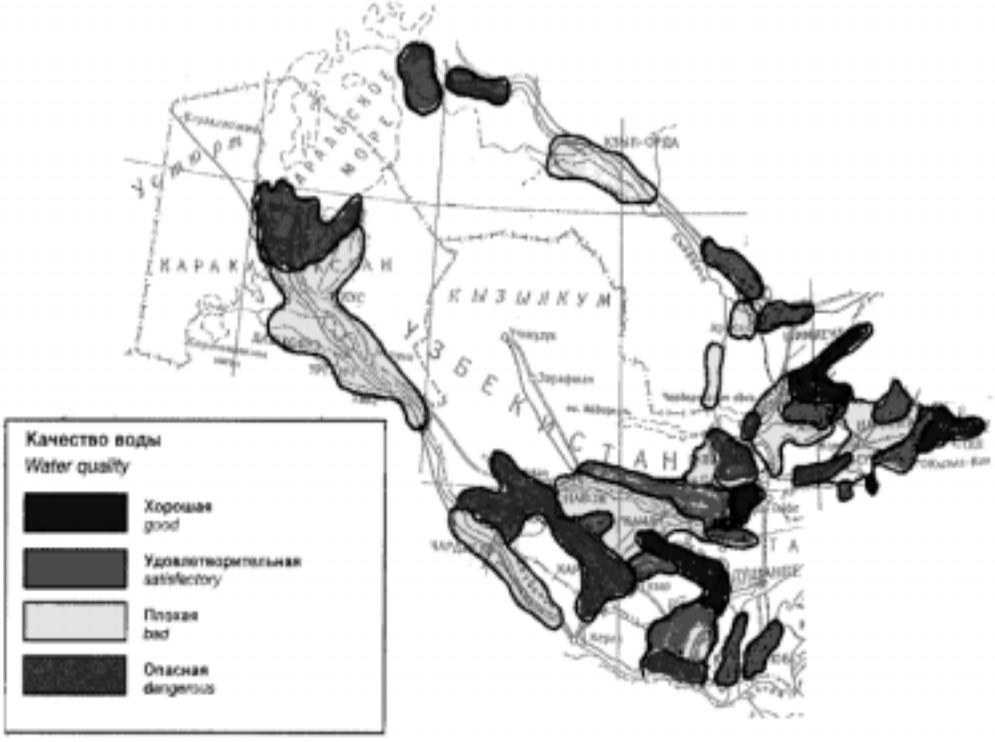


Figure 2.1: Quality of surface water in Uzbekistan
Source http://www.grida.no/enrin/htmls/uzbek/report/english/issue9.htm

Nearly all surface water bodies are characterised by water quality parameters that exceed the established Uzbek standards. Polluted reservoirs are located in densely populated industrial cities and outside urban areas. The organic substances and toxic compounds are dumped into the reservoirs and the concentration of heavy metals here sometimes exceeds the established Uzbek standards by 40 to 50 times. Mineralisation is increasing and is 4 to 5 times higher than standards, which is often linked with the agriculture drainage.

Over the last few years the reduction of the application of mineral fertilizers and pesticides in the agriculture and drastic reduction of contaminated waste discharged to water bodies has had a positive effect on the pollution situation but did not allow reaching the MACs.

The quality of groundwater that is used as the main source of water for cities and towns has declined significantly. As a result, 40% of known fresh groundwater is unsuitable for drinking. More than one third of the population uses drinking water that does not meet national standards, with serious impacts on health.

The analysis of the 50 most polluted river sections showed that the following parameters were of main concerns in the quality of Uzbek rivers:

Table 2.1: Average pollution identified over the most 50 main polluted rivers in RU (in the year 2000)

	Average times fishery MAC	Standard Deviation	Existing MAC mg/l
Chromium	2,25	1,70	0.001
Nitrites	2,20	1,63	0.02
Phenol	1,42	0,82	0.001
Oil Products	1,11	0,66	0.05
Fluorine	1,10	5,27	0.05
Copper	0,93	0,49	0.001
Mineralisation	0,77	0,47	1000-1500
O_2 dissolved	0,57	0,10	
BOD	0,48	0,32	3
Zinc	0,45	0,44	0.01
Nitrates	0,28	0,19	9.1
Ammonium ion	0,27	0,21	0.5
Iron (2+)	0,06	0,06	0.005
Arsenic	0,02	0,02	0.0001

Even if the reliability of data is questionable (as mentioned in the section 1.3.3) the very high level of standard deviations nevertheless shows that some rivers may have some critically high levels of some parameters (especially for chromium, nitrites, phenol, oil products, fluorine and copper).

To conclude this summary analysis, the MACs should first be reviewed in order to ensure that the baseline against which data are compared is realistically set such that regular exceedances of the limits can genuinely be interpreted as an indication of a problem. Then those elements that still exceed justifiable limits will have to be especially monitored in case they prove to be produced through industrial activities.

2.1.2 Water quality issues in river basins

Almost all river basins of the Aral Sea basin are trans-boundary basins, of which the most important are the Amudarya and the Syrdarya. Only the basins of the Kashkadarya and Sherabad rivers are located entirely within Uzbekistan's borders.

The Amudarya River Basin

The basin of the Amudarya River brings together many rivers, the most important ones being the Amudarya, the Surhandarya, the Kashkadarya, the Zerafshan and the Sherabad. The chemical composition of the Amudarya river is affected by contaminating discharges arising from agricultural activities in Turkmenistan and enterprises located in Termez.

The water of the Amudarya River arrives in Uzbekistan at the Termez river station, with mineralisation up to 600 mg/l and with small concentrations of salts and organic substances. In the river mouth, the content of salts and organic substances increase respectively to 1476 and 30 mg/l. The river is most contaminated at the location of Kziljar village by phenol (2 times MAC on average – maximum 6 times MAC[2]), oil products (1.8 - 5 MAC), ammoniacal nitrogen (0.1-0.3 MAC) and nitrates (0.7-4 MAC).

Partially, the flow of the Surhandarya River arises in Tajikistan. The chemical composition of the water in the river is affected by industrial and municipal wastewater discharges at Denaw, Termez and Shurchi, as well as by agricultural sources.

The chemical composition of the Kashkadarya River is affected by industrial and communal enterprises of cities such as Shahrizabs, Karshi as well as by irrigation drainage water. Mineralisation in the river reaches 1224 mg/l (1.2 MAC). Concentration of oil products reaches 0.41 mg/l (8 MAC).

The Zerafshan River is affected predominantly by trans-boundary influences. Discharges from the mining-enriching factories of Tajikistan contaminate the river with toxic metals and antimony. The Zerafshan River not only provides water supply for agriculture and industry, but also is the source of raw water for potable supply to Navoyi and some districts of the Bukhara region. It also forms the main reservoir deposits of fresh underground water in the Samarkand region.

The number of operating wastewater treatment plants in the basin of the Zerafshan river is as follows: 35 in Samarkand region, 17 in Buhara and 5 in Navoyi. Inefficient operations at most of the purification plants lead to contamination of the Zerafshan River, which is downstream of the cities of Samarkand and Navoyi. In the Samarkand industrial zone, such enterprises as a chemical factory, a mechanic factory and a leather processing factory discharge sewage water in the Sial and Taligulan canals that flow into the Karadarya River.

As a result of contamination in Mirzabarar (Aktash), Katta-Cherkent (Ingichk), Pahtachin (Pahtachi), Khatirchinskiy (Khatirchinskiy), since the beginning of 1980s, the levels of mineralisation, hardness and sulphates have increased from 10 up to 100 times MAC. The most dangerous pollutants of Navoyi area come from the mining-enriching workshop, the industrial complex "Navoiazot" and electrochemical plants. The PO "Navoiazot"

[2] (2 times MAC on average – maximum 6 times MAC[2]) will be further written: (2 – 6 MAC). (2 MAC) will further mean (2 times MAC on average)

discharges to the Zerafshan River sewage water with high level thiocyanate (up to 200 MAC) and ammonia (5 MAC). Nitrates (1-6 MAC), combined fluorine (1.6 MAC), strontium (1.5 MAC) and manganese (up to 10 MAC) are found in the underground water nearby factories' treatment plants.

Water is most contaminated in the river below the city of Navoyi. Maximum concentrations of contaminating substances are: phenols (5 MAC), oil-products (1.6 to 13 MAC), chromium (4 to 11 MAC) and copper (2.6-5 MAC).

The Syrdarya River Basin

The basin of the Sirdarya River includes many rivers, the most important of which are the Sirdarya, the Narin, the Karadarya, the Chirchik and the Akhangaran. Only the Chirchik and the Akhangaran are not transboundary watercourses.

The chemical composition of water in the Syrdarya River is affected by municipal and agricultural wastewater. Mineralisation fluctuates between 0.9 to 2.2 times MAC on average. The river is mostly contaminated by organic substances below the settlements of Bekabad and Nadejdinskiy. There is a danger of contamination of Syrdarya River with toxic radioactive wastes arriving via the Maylisu River from Kyrgyzstan, which has tailing pits and dumps from extraction of uranium ores.

The Karadarya River is contaminated by sewage effluents from the cities of Andijan, Assaka and Hanabad, as well as by overflows from the collector sewers.

The Akhangaran River is one of the largest tributaries of Syrdarya River. The chemical composition of the river is determined mainly by discharges from municipal enterprises at Angren, Ahangaran and Almalik. Mineralisation increases from the source to a level of 1071 mg/l at the mouth. Concentrations exceeding the MACs have been observed for copper, oil-products, phenol, nitrite nitrogen and organo-chlorine pesticides (isomers GHTSG).

The quality of groundwater is compromised by seepage of flows from the industrial areas of the Almalic mining-metallurgical workshops (AGMK), PO "Ammofos", the dumps of phosphogypsum, sewage from treatment plants and the dumps of industrial and domestic solid wastes. As a result, mineralisation rises to 1.6 MAC, cadmium to 2 MAC and selenium up to 2MAC. As a result of this, in the neighbouring of industrial areas, the groundwater has been unsuitable for drinking water supply for the last 10 years. In certain areas of Kokaral massif, mineralisation and hardness of groundwater reached 1.7 MAC, sulphates 2 MAC, selenium 6 MAC and cadmium 2 MAC.

The Chirchik River is the largest tributary of Syrdarya River. Due to excessive water use and leakage, the residual flow in the Chirchik is sometimes reduced to zero. Hydro-systems at Gazalkent and High Chirchik result in a total diversion of the upstream Chirchik flow. Downstream, the river flow is mainly formed by small tributaries and by industrial and municipal wastewater.

In all phases of hydrological regime, the water, according to its chemical composition, belongs to the chloride class, to the groups of sodium and potassium. COD fluctuates from 2 to 34 mg/l. The chemical composition of the river's water is significantly affected by the contaminants released by the industrial and communal enterprises of cities such as Gazalkent, Chirchik, Tashkent, Yangiyul and Chinaz and by agricultural drainage. About 80 treatment plants are located in the basin of the rivers from which more than 40% work inefficiently.

Mineral nitrogen contamination is mainly released by the Chirchik Industrial Complex "Electrohimprom". A high level of contamination of groundwater by nitrogen compounds in the middle of Chirchik river basin has been recorded for many years (3-6 MAC). "Electrohimprom", UzKTJM and quarries of non-metallic materials appeared to be the objects of contaminations for mineralisation (3 to 8 MAC), caprolactam[3] (1 to 10 MAC), oil products (12 to 20 MAC) as well as tungsten, molybdenum and iron.

2.2 Analysis of industrial water pollution

2.2.1 Introduction to the Industrial sector of Uzbekistan

Uzbekistan is undergoing a transition from a centrally planned economy to a market-orientated economy. This transition has not been easy but key economic indicators have stabilised and began to improve from 1995 onwards (cf. Environmental Performance Review, UN, 2001). In spite of the impacts of the global financial crisis and regional instability on the economy of Uzbekistan in 1998, there was a real growth in GDP from 1996 to 2000. This could be partly explained by early investments in the energy sector (especially oil and gas). In 1999, the partition of the national economy followed the following Figure 2.2.

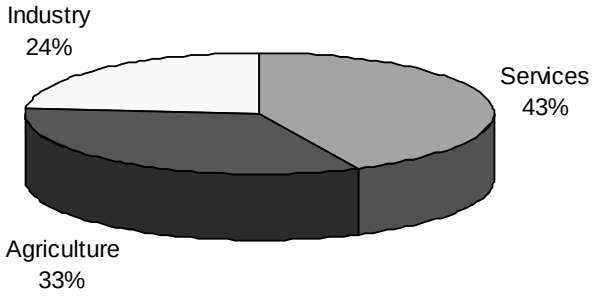


Figure 2.2: Partition of the industrial sector in Uzbekistan in 1999

Uzbekistan has substantial hydrocarbon resources (oil reserves of about 350 million tons and gas reserves of about 2 trillion cubic metres) as well as ample resources of copper, silver, gold, lead, zinc and tungsten. Consequently, industries based upon oil, chemicals, energy and mining are quite important in Uzbekistan. The textile industry is also quite developed, being based upon cotton as the most important crop.

In the Republic of Uzbekistan, the majority of industrial sites are located in Tashkent (40%), Ferghana (27%), and the Samarkand and Navoyi regions (20%). Consequently there is a high concentration of industrial sites within the relatively small area covered by those oblasts.

[3] A cyclic amide-type compound, containing 6 carbon atoms

2.2.2 Quantity of industrial wastewater

There are about 16,000 water consumers in the Republic[4] from which about 8,000 are involved in the industrial branches (inc. industries that discharge their wastewater into municipal sewers).

As demonstrated by the figure 2.3, agriculture is by far the main water user.

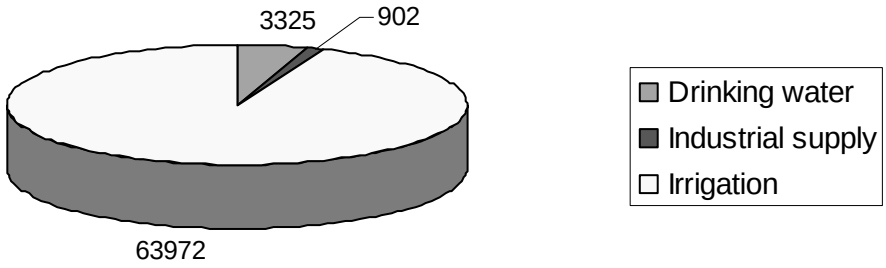


Figure 2.3: Water use in Uzbekistan (in the year 1998, million m3)
Source: National Action Environmental Plan, SNCP, 2000.

Despite the relatively small volume of industrial wastewater (less than 18% of the total wastewater discharged into surface water bodies), industry is one of the main sources of contamination of surface and ground water. There are three receptors of industrial discharge: water objects (rivers, lakes and open collectors and canals), to natural depressions (infiltration areas) and municipal sewer system as shown in Table 2.2.

Table 2.2: Repartition of direct and indirect discharges in RU (% of total volume of industrial discharges).

Direct discharges	To surface water	93%
	To natural depressions	2%
Indirect discharges	Municipal sewer	5%

About 26 billion m^3 per year of collected and drained water are discharged into the surface water bodies:

- 40 % are discharged into the Syrdarya
- 20 % into the Amudarya
- 40 % into small rivers, hollows, saline lakes etc.

Agriculture is the main wastewater discharger since it drains about 20 billion m^3 per year. The other 6 billion m^3 are discharged by the almost 500 wastewater dischargers directly into the surface water objects of the country[5]. Direct industrial effluents ranged from 5077 million m^3 in 1990 to 4154 million m^3 in 2000 (cf. table 2.3).

[4] Until 1995, the State statistical report (from the 2TP system) included more than 6,000 water consumers from industrial, agriculture and municipal objects.
[5] Which means that the discharges in the open drainage collectors are not taken into consideration

Table 2.3: Volume of water discharged from the industrial sector directly in surface water objects (million m^3 / year)

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total	5077	4761	4486	4534	4514	4801	4801	4580	4507	4366	4154
Inc. volume not fulfilling the standard (higher than ELV)	304	240	267	256	151	200	351	161	135	137	161
Inc. volume fulfilling the ELV standards after treatment	86	94	109	91	241	182	233	222	176	134	129

As shown in this table, the decline in industrial output caused the reduction of wastewater flow into the surface water objects. It is thought that the industrial level of production reached its lower point in 2000. This sharp reduction of volume sewage water effluents sometimes induced insufficient flow of sewage water to the treatment plants, which contributed to poor functioning and poor pollution abatement. Nevertheless, the present economic recovery could reverse this trend rapidly.

Wastewater from industrial and municipal sectors released into a local depression such as tail reservoirs, stock ponds, pits and oxidation ponds reached 50 million m^3 in 2000.

2.2.3 Quality of industrial wastewater

Industrial wastewaters are classified according to its quality parameters:

- **Clean** according to standards and which don't require treatment
- **Polluted**:
  - Untreated
  - Insufficiently purified by the treatment plant
- **Properly treated** according to standards through the treatment plants

More than 60% of industrial wastewaters are clean. These include mainly water used after cooling electric power stations, runoff from fishing ponds, drainage water pumped for reducing the level of subsurface water table on the territory of enterprises, etc. From the remaining 40%, 75% of wastewaters undergo some kind of treatment.

The effluents from the enterprises of ferrous and non-ferrous metallurgy, chemistry, oil-chemistry, gas, oil extraction and processing, energy and industrial building materials are the most polluting in RU. The main pollutants identified in industrial wastewater are iron, oil, organo-chlorine pesticides and other organic substances, heavy metals and dry sediments.

Wastewater from energy complexes represents more than 90% of the total amount of industrial discharge and increases temperature, mineralisation, suspended particles and sometimes oil products in the surface water.

Enterprises of non-ferrous and black metallurgies represent only 0.6 % from the total amount of effluents into the streams but more than 80% of the collected liquid and solid wastes. Difficulty of the problem of water resources protection from the metallurgical contamination is caused by the various ways the water is used and the diversity of raw materials: suspended particles, nitrogen group, oil-products, mineralisation, heavy metals and others. The most significant pollutants in tail waters include copper (9 mg/l on

average), zinc (0.1 mg/l), arsenic (2.5 mg/l), magnesium (980 mg/l) and carcinogenic substances that infiltrate the groundwater.

Manufacturing of mineral fertilisers prevails in the chemical and petrochemical industries. The volume of wastewater discharged into water bodies consists of on average 4% of the total industrial discharge. The single largest industrial water user is the Chirchik industrial association "Electrohimprom" (wastewater contaminated with nitrogen compounds). These effluents make a great influence on the quality of the Chirchik River and underground drinking water supply for city of Tashkent.

The enterprises of the oil and gas industry are located in Ferghana, Kashkadarya, Navoyi and Bukhara regions and cause geo-chemical contamination on all stages of development and exploitation of deposits. More than 50% of sewage water is discharged without preliminary purification to evaporation ponds that causes the contamination of soil and groundwater. Imperfection of the system of collection, transportation and processing of gas-form products causes the leakage of oil products and the contamination of the environment.

Food and consumer goods industries despite its small sewage flow rate (0,5% from total amount of industrial discharge in surface water and more than 10% into ponds) contaminate water bodies inducing high concentrations of ether soluble nitrogen compounds, BOD, dyestuffs and iron.

The main reasons that cause the intensive contamination of the environment by industrial enterprises are:

- Old technologies being used for industrial production
- Insufficient re-circulation and re-use of water resources
- Deficiencies in the design, operation and maintenance of the wastewater treatment plants
- Low quality storage ponds with irregular check up and repair of equipment
- Inappropriate storage for solid wastes.
- Unsatisfactory monitoring of the quantity and quality of effluents
- Enterprises location in water protection and sanitary zones with an irrational allocation of enterprises on the territory of the republic
- Lack of qualified employees and training centres.

2.2.4 Impact of the effluent discharges on the ground water quality

Groundwater volume in Uzbekistan totals 19.7 cubic km and 6.8 cubic km are exploited. The ground water of the best quality is in the east of Uzbekistan (I, II and V hydro-geological areas which covers 60% of total potential water reserves and 70% of the total ground waters). In these areas, the overall quality meets the standard[6] requirements for drinking water.

As a result of irregular and non-balanced distribution of the ground drinking water reserves, the regions in the west of the republic suffer from an acute deficit of drinking water (Karakalpakstan, Khorezm and Bukhara provinces and the territories in the west of the Samarkand, Kashkadarya, Djizak and Surkhandarya provinces). Twenty years ago the groundwater of the listed regions met the requirements set for the drinking water sources but the intensive development and cultivation of new lands, extra effluents discharged

[6] O'zDST 950:2000

from collectors and irrigated lands as well as industrial discharges have resulted in the mineralization of the surface and ground water. The development of the ground drinking water along the large watercourses indeed expose them to the pollution of surface water that are associated with them.

Local contamination also progresses due to the penetration into ground waters of the industrial discharges. There are about 500 large industrial centers of contamination in the territory of the republic, most of them being located in the industrial regions of Tashkent, Chirchik, Almalyk-Akhangaran, Ferghana-Margilan, Samarkand and Navoi.

2.3 Main "Categories of industries" in Uzbekistan

2.3.1 Existing categories of industries

From the Soviet time, most industries in Uzbekistan have used the "Integrated Standards of Water Consumption and Water Flow", which gives standards figures for different industrial activities. This manual classifies the different types of activities and for each of them it describes what are the water requirements according to the process used. It also describes what kind and what level of pollution will result from such activities. This manual is largely used to prepare the ELV by both industries and the licensing units of the SCNP. The categories of industrial activities (also called SEV codes) covered by this manual are presented in Annex 4. As a first analysis, it was proposed to select the key types of activities from this list, since it will enable to match the selection with the existing practices.

To start with, the Project analysed the twenty main industries of Uzbekistan that discharge their wastewater directly into water objects as well as their types of activities (through their SEV codes). These 20 industries discharge 61% of the total treated[7] industrial wastewater in the RU and are therefore representative of the main industrial industries. They were gathered per SEV codes, which resulted in the following table:

[7] As described in table 2.3, a large amount of industrial wastewater is discharged without treatment since it is generally below MAC. This amount was not included in our analysis and statistics in order to remove such bias and to concentrate on the effluents that need treatment.

Table 2.4 Types of industries discharging directly in the rivers (thousand m3 per year)

SEV Label	SEV Code	1990	1995	2000
Coal and shale enterprises	1-A		17810	14156
Mining manufacturing (ferrous metallurgy)	3-A	491	359	175
Ferrous and non-ferrous metallurgy	3-A & 4	2333	2468	3451.9
Non-ferrous metallurgy	4	350	3498	2738
Basic chemical production	7-B		137021	121500
Production of Chorine and Organic compounds	7-B & D	6939	4151	1058.5
Nitrogen industry	7-C	58742	48383	29718
Hydrolytic factories, wineries and breweries etc.	8-C & 11-I	4407	3333	2897
Enterprises of pre-processing flax, hemp, wool, silk & Enterprises of fibre production	10-A & B	10417	3493	1916
Enterprises of meat industry	11-D	351	351	146
Enterprises of fat and oil industry	11-F	2065	782	685.6
Engineering industry	12	26	749	555
Electrical industry	13	162	110	73
Enterprises of sanitary-technical equipment & Manufacturing of concrete products and construction	14-C & F	2322	1642	1642
	Total	88605	224150	180712

The industries that discharge their wastewater in the municipal sewer systems were also analysed. The main industries discharging in the 5 main industrial cities of the RU were identified and data regarding the volume of wastewater discharged for the year 2000 was obtained. These cities are Tashkent, Chirchik, Samarkand, Almalyk and Fergana.

The same analysis was applied to indirect dischargers as had been early applied to direct industrial discharges, resulting in Table 2.5.

Table 2.5: Types of industries discharging their effluents in the municipal sewers (in the year 2000).

SEV label	SEV code	Volume of sewerage Discharge (thous. m3/year)
Industry of Heat and power engineering	2	16 849
Metallurgical factories and workshops	3-B	760
Oil-refining and petrochemical industry	6	25 258
Basic chemical production	7-B	5 268
Nitrogen industry	7-C	18 250
Enterprises of paintwork industry	7-E	993
Chemical fibres production	7-H	1 989
Enterprises of preprocessing flax, hemp, wool, silk	10-A	1 825
Enterprises of fibre production	10-B	14 884
Enterprises of knitting, stocking and clothing industry	10-C	1 210
Leather-shoe enterprises	10-D	1 331
Dairy and meat industry	11-C & D	1 838
Enterprises of fat and oil industry	11-F	5 037
Wineries and breweries	11-I	340
Engineering industry	12	34 487
Electrical industry	13	5 358
Other industrial branches	15	1 651
	Total	137 328

2.3.2 Selection of "Categories of industries"

A cross-analysis of Tables 2.4 and 2.5 for the year 2000 enabled determination of the overall discharge per SEV groups. A multi-criteria analysis resulted in a summary of industrial effluents in the RU by industrial category (see Table 2.6).

Table 2.6: Main Industrial Categories and their discharge of effluents in RU (in the year 2000)

Proposed label of Category	Proposed Code	SEV Code	Volume (thous. m3)	% of total	Comments
Basic Chemical Manufacturing	7-B	7-B	126768	42,1%	
Nitrogen and other chemical production	7-C-D-E-H	7-C	47968	15,9%	
		7-H	1989	0,7%	Only one industry but dirty effluents
		7-E	993	0,3%	Two main industries
		7-B & D	1058,5	0,4%	
Engineering and Electrical Production	12&13	12	35042	11,6%	Same pollution
		13	5431	1,8%	Chrome and galvanic products
Oil refining and petrochemical industry	6	6	25258	8,4%	
Textile Industry	10&8C	10-B	14884	4,9%	
		10-A & B	1916	0,6%	
		10-A	1825	0,6%	
		10-D	1331	0,4%	
		10-C	1210	0,4%	
		8-C & 11-I	2897	1,0%	Only one industry, dirty effluents, mainly spirit production so with 11
Food Industry	11	11-F	5722,6	1,9%	
		11-C & D	1838	0,6%	
		11-I	340	0,1%	
		11-D	146	0,0%	
Metallurgical Industry (inc. non-ferrous)	3&4	3-A & 4	3451,9	1,1%	Discharge in reservoirs and ground water pollution
		3-A	175	0,1%	
		3-B	760	0,3%	
		4	2738	0,9%	
Not selected		1-A	14156	4,7%	Clean industries
		15	1651	0,5%	
		14-C & F	1642	0,5%	One enterprise but not polluting
		Sum	301191		

This table allowed final selection of the representative industrial groups:

Table 2.7: The 7 main Industrial groups representative of the Uzbek industrial sector.

Names of identified group	SEV codes	Volume (2000) (thous.m3)	%
Basic chemical production	7-B	126 768	45%
Nitrogen and other chemical production	7-C-D-E-H	52 009	18%
Engineering and Electrical Production	12&13	40 473	14%
Oil refining and petrochemical industry	6	25 258	9%
Textile Industry	10&8C	24 063	8%
Food Industry	11	8 047	3%
Metallurgical Industry (black and non-ferrous)	3&4	7 125	3%
	Total	283 742	

2.4 Selection of key parameters for each Industrial Category

On the basis of the of the SEV manual and local knowledge and laboratories' capacities, key parameters were selected for each industrial category. A preliminary selection of 25 parameters was discussed with various state institutions involved in water quality control, as well as with laboratories. This process resulted in the identification of parameters that could serve as indicators for each industrial category. Based on this analysis, Table 2.8 was developed.

Table 2.8: Key parameters for each category of industry

		Polluting parameters								
	SEV Group	1	2	3	4	5	6	7	8	9
Basic chemical production	7-B	SS	Ether soluble	Mineralisation	Fe	Arsenic	$PO4^{3-}$	NH4	BOD	
Nitrogen and other chemical production	7-C-D-E-H	SS	BOD	COD	NH4	NO3	NO2	Oil products	Mineralisation	Fe
Engineering and Electrical Production	12&13	SS	Ether soluble	pH	SSAS	COD	Fe	Cu	Cr	Zn
Oil refining and petrochemical industry	6	COD	BOD	Oil products	SSAS	Phenol	NH4			
Textile Industry	10&8C	SS	BOD	COD	NH4	SSAS	$PO4^{3-}$	Cr	Ether soluble	
Food Industry	11	SS	Ether soluble	COD	BOD	SSAS	NH4	$PO4^{3-}$	Oil products	
Metallurgical Industry (black and non-ferrous)	3&4	SS	SSAS	Cu	Pb	Fe	Fluorine	Arsenic	Phenol	COD

The previous table includes only 20 parameters that could be used to represent the main industrial pollution in Uzbekistan. These parameters are gathered in the following table:

Table 2.9: Selected parameters representing industrial pollution

Group	Parameters	Code
Group1: Biological and physic-chemical parameters	COD	1
	BOD_5	2
	pH	3
	Suspended Solids	4
	Mineralisation	5
Group 2: Nitrogenous and phosphate compounds	Total ammoniacal nitrogen	6
	NO_2^-	7
	NO_3^-	8
	PO_4^{3-}	9
Group 3: Toxic non-organic substances	Ether soluble substances	10
	Oil products	11
	SSAS (Synthetic Surface Active Substances)	12
	Phenol	13
Group 4: Toxic chemical parameters	Fluoride	14
	Arsenic	15
Group 5: Metals	Fe	16
	Cr (VI)	17
	Cu	18
	Zn	19
	Pb	20

3 PROPOSAL OF ENVIRONMENTAL QUALITY STANDARDS

This section is based on sub-project Activity 10i(3).

3.1 Description of the EU water quality standard:

3.1.1 "The Normative Approach"

In the past, European countries dealt with many different normative directives linked to the quality of the aquatic environment and to wastewater discharges.

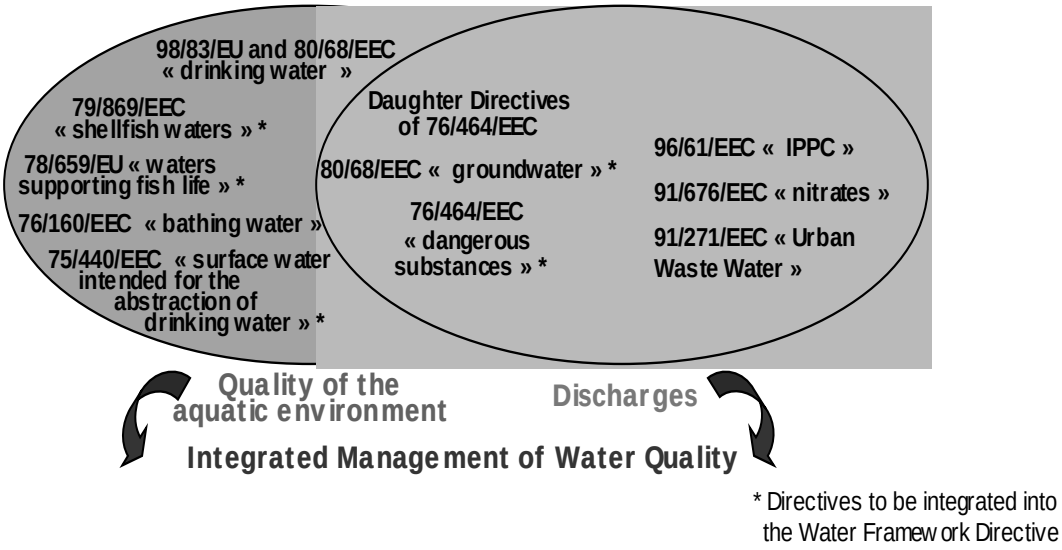


Figure 3.1: EU normative directives in the water sector

The new Water Framework Directive "combines" and integrates many previously existing Directives in order to avoid legislative overlaps.

3.1.2 "The Combined Approach" of the new water framework directive

The water framework directive combines two approaches:

i. The "Normative Approach" through reduction of pollution at the source by fixing emission limit values for Priority Substances

ii. The "Objective Approach" through the development of objectives for environmental quality of the Main Pollutants in order to reach the "good" status of surface and groundwater.

Using the action framework of directives on dangerous substances (76/464/EEC) and groundwater (80/68/EEC) and applying the Combined Monitoring-based and Modelling-based Priority Setting (COMMPS) procedure[8], a list identifies the 32 Priority Substances that are shown to be of major concern for European Waters. Once the list of priority substances is adapted, the Commission will propose community-wide water quality

[8] The application of the COMMPS implied the processing of about 820 000 monitoring data from waters and sediments from all Member States were evaluated and data for more than 310 substances on production, use and distribution in the environment.

standards and emission controls for the priority substances. Within the list of priority substances the Commission has identified the priority hazardous substances that are of particular concern for the freshwater, coastal and marine environment. These substances will be subject to cessation or phasing out of discharges, emissions and losses within an appropriate timetable that shall not exceed 20 years.

Annex VIII of the Framework Directive gives an indicative list of the Main Pollutants that should be reduced on a priority basis:

1. Organohalogen compounds and substances that may form such compounds in the aquatic environment.
2. Organophosphorous compounds.
3. Organotin compounds.
4. Substances and preparations, or the breakdown products of such, which have been proved to possess carcinogenic or mutagenic properties or properties which may affect steroidogenic, thyroid, reproduction or other endocrine-related functions in or via the aquatic environment.
5. Persistent hydrocarbons and persistent and bioaccumulable organic toxic substances.
6. Cyanides.
7. Metals and their compounds.
8. Arsenic and its compounds.
9. Biocides and plant protection products.
10. Materials in suspension.
11. Substances that contribute to eutrophication (in particular, nitrates and phosphates).
12. Substances that have an unfavourable influence on the oxygen balance (and can be measured using parameters such as BOD, COD, etc.).

3.2 Existing ‘water use categories’ in Uzbekistan

Water use categories define ambient water quality, based upon the use for which the water is required to be suitable.

Two sets of standards (inherited from the Soviet time) are the basis of regulation of water quality (represented by the MACs) for the following water uses:

1. Bathing and recreational activities
2. Fishery

A ministerial decree from the Soviet Ministry of Agriculture was used to regulate the quality requirement for irrigation water, but it does not seem to be used or applied.

3.3 Proposal of 'water use categories'

The classical main uses and 'functions' of water resources include:

- Drinking water supply
- Bathing and other recreational water contact activities
- Industry
- Fish farming
- Irrigation;
- Drinking water for livestock;
- Ecological functioning of aquatic ecosystems.

The requirement for water quality varies from one use/function to another. For example, the presence of organic and oxidisable matter will affect the suitability of water for treatment for drinking water supply for and fish farming and will have an impact on its ecological status but will have less impact on bathing or recreation activities. Table 3.1 summarises the impact of several water quality indicators on water uses and ecological status.

Table 3.1: Relationships between quality indicators and water uses and ecological function of aquatic ecosystems (Agences de l'Eau, France,1997).

	Function		Uses			
Indicators	**biological potential**	**drinking water**	**bathing and recreation activities**	**irrigation**	**drinking water for livestock**	**fish farming**
Organic and oxidisable matter	✓	✓				✓
Nitrates	✓	✓			✓	✓
Other nitrogen compounds	✓				✓	✓
Phosphorus compounds	✓					✓
Material in suspension	✓	✓	✓			✓
Colour		✓				
Temperature	✓					
Mineralisation		✓		✓	✓	✓
Acidification	✓	✓		✓		✓
Micro-organisms		✓	✓	✓	✓	
Phytoplankton	✓	✓				✓
Inorganic micropollutants	✓	✓		✓	✓	✓
Pesticides	✓	✓		✓	✓	!
Organic micropollutants (excl. pesticides)	✓	✓				

✓ Function and use qualitatively influenced by the indicator
Blank Function and use not or slightly influenced by the indicator
x Needs further investigation

(1) Defined as the biological potential or the suitability of a water body to satisfy the needs for animal and plant life which depend on physical-chemical and physical (habitat, hydromorphology) status of surface waters

For Uzbekistan, we propose 4 categories: the two existing ones (Fishery and Bathing) and two new ones: Irrigation and Abstraction for drinking water supply.

3.4 Comparison of Uzbek and European Standards

3.4.1 Bathing & Recreational water

The Council Directive 76/160/EEC of 8 December 1975 concerns the quality of bathing water and was amended by the following measures:

- Council Directive 90/656/EEC of 4 December 1990;
- Council Directive 91/692/EEC of 23 December 1991

The Guideline values are presented in Table 3.2. As for the EU directive, French values are limited to bacteriological parameters, the number in bold is the only one being directly included in the French legislation for recreational waters. The others limits correspond to the medium classes used in the French classification SeqEau[9]. This classification is used in France for river basin planning and for defining water quality objectives in rivers.

Table 3.2: Comparison of Uzbek and EU standards for bathing & recreational water for the selected parameters (mg/l)

		Bathing & Recreation			
	Parameter	Uzbekistan	EU (1)	France (2)	Recommended
	COD	NES		40	40
	BOD_5	6		10	10
	pH	6.5 – 8.5	6 to 9	5.5 to 9	6 to 9
	SS	30		25	30
	Mineralisation	1000 to 1500		1000	1500
	Total ammonical nitrogen	2	TDEC	2	2
	NO_2^- (nitrites)	3.3	TDEC	0.5	0.5
	NO_3^- (nitrate)	45	TDEC	25	25
	PO_4^{3-}			1 (PO_4^{3-}) 0.5 (total)	1
	Ether soluble substances	0.8			0.8
	Oil products	0.3	No visible and no odour	0.3	0.3
	SSAS	0.5	0.3		0.5
	Phenol	0.001	0.005	0.001	0.005
	Fluoride	1.5			1.5
	Arsenic	0.1	TDEC	0.07	0.1
	Fe	0.5			0.5
	Cr (VI)	0.1	TDEC		0.1
	Cu	1		0.015	1
	Zn	1		0.1	1
	Pb	0.03	TDEC	0.03	0.03

NES: No Existing Standard
TDEC: To be Determined by Each Country

[9] More information about SeqEAU and the French Water Data Network on http://www.rnde.tm.fr/anglais/rnde.htm

3.4.2 Fishery use

The Council Directive 78/659/EEC of 18 July 1978 concerns the quality of fresh waters needing protection or improvement in order to support fish life. This directive was amended by the following measures:

- Council Directive 90/656/EEC of 4 December 1990;
- Council Directive 91/692/EECof 23 December 1991.

The Guideline values are here reported. The French limits correspond to the medium classes for fishery water (yellow colour in the SeqEau classification).

Table 3.3: Comparison of Uzbek and EU water standards for fishery uses and for the selected parameters (mg/l)

	Fishery	EU (2)			
Parameter	Uzbekistan	Salmonid	Cyprinid	France	Recommended
COD	15	30		30	30
BOD_5	3	3	6	6	6
pH	6.5 - 8.5	6 to 9	6 to 9	6 to 8.5	6 to 9
SS	15	25	25	50	25
Mineralisation	1000-1500			800	1000
Total ammoniacal nitrogen	0.5	1	1	0.5	1
NO_2^-	0.02	0.01	0.03	0.1	0.1
NO_3^-	9.1			10	10
PO_4^{3-}	0.3	0.2	0.4		0.3
Ether soluble substances					*0.8***
Oil products	0.05	No visual and no taste	No visual and no taste		No visual and no taste
SSAS	0.5				0.5
Phenol	0.001	Taste	Taste		Taste
Fluoride	0.05				0.05
Arsenic	0.0001			0.1	0.1
Fe^{2+}	0.005				0.005
Cr (VI)	0.001			0.018	0.02
Cu	0.001	0.04*	0.04*	0.01	0.01
Zn	0.01	0.3*	1*	0.04	0.04
Pb	0.1			0.05	0.1

* The values given here correspond to a water hardness of 100 mg/l. For hardness levels between 10 and 300 mg/l, corresponding limit values can be found in Annex II of the directive 78/659/EEC.
** By lack of standards, the value for bathing is here used

The requirements for raw water for potable supply that are given above are required in cases where the only treatment provided prior to supply is simple filtration and disinfection. In cases where more advanced treatment is provided, the requirements should be reviewed in the light of, for example, Annexes I and II of European Community Directive 75/440/EEC of 16 June 1975 concerning the quality required of surface water intended for the abstraction of drinking water in the Member States.

3.4.3 Raw water for drinking water supply: “Potable water”

EU council directive 75/440/EEC concerns the quality required of surface water intended for the abstraction of drinking water in the Member States (Annex II). It includes three levels of standards depending on the level of technology used to treat the raw water for drinking water supply. The third level was not reported here since compliance would require technology for which investment funds are not currently justifiable in Uzbekistan.

EU (1): Simple physical treatment and disinfection (e.g. filtration and disinfection)

EU (2): Normal physical treatment, chemical treatment and disinfection e.g. pre-chlorination, coagulation, flocculation, decantation, filtration and disinfection (final chlorination)

Like for the two previous chapters, the French values mix the legal (in bold) and SeqEau ones.

Table 3.4: Proposal for “potable water” standards using EU and French standards (mg/l)

	Raw Water			
Parameter	EU (1)	EU (2)	France (3)	Recommended
COD		*30*	30	30
BOD_5	3	5	10	3
pH	6.5 to 8.5	5.5 to 9	5.5 to 9	5.5 to 9
SS	25		50	25
Mineralisation				*1000*
Total ammonical nitrogen	0.05	1	0.5	0.3
NO_2^- (nitrites)			0.5	0.2
NO_3^- (nitrate)	25	50	50	25
PO_4^{3-}			0.5	0.5
Ether soluble substances				*0.8*
Oil products				*0.3*
SSAS				*0.5*
Phenol	0.001	0.005	0.001	0.001
Fluorine (mg/l F)	0.7 to 1	0.7 to 1.7		1
Arsenic	0.01	0.05	0.01	0.01
Fe	0.1	1		0.1
Cr (VI)			0.05	0.05
Cu	0.02	0.05	0.0025	0.02
Zn	0.5	1	5	0.5
Pb	0.05	0.05	0.01	0.05

Italic figures were borrowed from the bathing standards since none of the analysed legal documents gave some standards for these indexes.

3.4.4 Irrigation water

There are no existing EU standards for water to be used for irrigation. Nevertheless, since the irrigation sector uses more than 90% of the whole water resources used, it was proposed to develop some standards for the “irrigation water use”.

The US being also quite concerned with irrigation developed some recommendations that are here reported. All the French figures here reported are all extracted from the SeqEau classification for irrigation water uses.

Table 3.5: Proposal for “irrigation water” standards (mg/l)

	Irrigation Water			
Parameter	EU	US*	France (3)	Recommended
BOD_5	None		40	40
BOD			10	10
pH		6.5 to 7	5.5 to 9	6.5 to 9
SS			50	50
Mineralisation		525-1400		1000
Total ammonical nitrogen			1.5	1.5
NO_2^- (nitrites)			0.5	0.5
NO_3^- (nitrate)			25	25
PO_4^{3-}			1	1
Ether soluble substances				*0.8*
Oil products				*0.3*
SSAS				*0.5*
Phenol				*0.001*
Fluorine (mg/l F)		1		1
Arsenic		0.1	0.1	0.1
Fe		5		5
Cr (VI)		0.1	0.1	0.1
Cu		0.2	1	1
Zn		2	5	5
Pb		5	0.2	0.2

* from Rowe and Abdel-Magid, 1995

3.5 Summary proposal for effective ambient water quality standards

The following table stands as a synthesis of the four previous chapters:

Table 3.6: Synthesis of the proposed ambient water quality standards for the key 20 ingredients in Uzbekistan and for the 4 main water uses (mg/l)

All limits are expressed in 90th percentile

	Parameter	Fishery	Bathing	Raw water *	Irrigation
1	COD	30	40	30	40
2	BOD_5	6	10	3	10
3	pH	6 to 9	6 to 9	5.5 to 9	6.5 to 9
4	SS	25	30	25	50
5	Mineralisation	1000	1500	1000	1000
6	Total ammonical nitrogen	1	2	0.3	1.5
7	NO_2^- (nitrites)	0.1	0.5	0.2	0.5
8	NO_3^- (nitrate)	10	25	25	25
9	PO_4^{3-}	0.3	1	0.5	1
10	Ether soluble substances	*0.8*	0.8	0.8	0.8
11	Oil products	No visual and no taste	0.3	0.3	0.3
12	SSAS	0.5	0.5	0.5	0.5
13	Phenol	Taste	0.005	0.001	0.001
14	Fluorine (mg/l F)	0.05	1.5	1	1
15	Arsenic	0.1	0.1	0.01	0.1
16	Fe	0.005	0.5	0.1	5
17	Cr (VI)	0.02	0.1	0.05	0.1
18	Cu	0.01	1	0.02	1
19	Zn	0.04	1	0.5	5
20	Pb	0.1	0.03	0.05	0.2

* The requirements for raw water for potable supply that are given above are required in cases where the only treatment provided prior to supply is simple filtration and disinfection. In cases where more advanced treatment is provided, the requirements should be reviewed in the light of, for example, Annexes I and II of European Community Directive 75/440/EEC of 16 June 1975 concerning the quality required of surface water intended for the abstraction of drinking water in the Member States.

4 EMISSION LIMIT VALUES FOR POINT SOURCE DISCHARGES

The aim of this section (designed in the activity 10i(4) of the Project) is to propose a methodology to workout standards that will apply to point source discharges of industrial and municipal wastewater. The activity develops a clear methodology for calculating ELV in order to have a reasonable expectation of meeting the ambient standards.

4.1 Effluent standards: the technological or the environmental approach?

There are two approaches for regulating effluent discharge quality:

- Environmentally based limit values. These consider the required state of the receiving water body, the actual state of the water into which the discharge is to be made and the specific impacts of the discharge in question. The emission limit values are therefore a function of the ambient river quality and the downstream river quality objective. This is the approach that is adopted in the majority of cases in Great Britain.

- Technology based limit values. These are determined according to what is deemed technically feasible. The emission limit values do not depend upon a case-by-case consideration of environmental requirements. Limit values are based on the best technical means for reducing discharges taking into account the economic availability of those means. This is the more common approach among other Member States of the European Union.

There are advantages and disadvantages in both of these approaches. These are being recognised by all of the EU Member States and, increasingly, both methods are used.

Table 4.1: Advantages and disadvantages of the technological and environmental approaches.

Approach	Advantages	Disadvantages
Environmentally based limit values	- They reflect the requirements and sensitivity of the environment, taking into account public health and ecological factors. - They will not be stricter than necessary, so the financial burden of pollution control may be less. - They allow a greater degree of correlation between discharge permits and environmental requirements. - They provide an indirect mean of regulating the growth of industry in environmentally sensitive areas.	- Determination of ELVs requires a case-by-case consideration of impact upon the receiving water body. - Their use requires more experience and understanding on the part of the competent authority.
Technology based limit values	- They are simpler to administer. - Their determination is not sensitive to the availability of environmental data. - They create a so-called “level playing field” [10].	- They do not guarantee that environmental objectives will be met, because there is no correlation between environmental requirements and emission limit values. - They do not provide a basis for prioritisation of investments in a developing economy.

The technology-based approach has the potential to work effectively in countries whose economy is sufficiently strong to enable the majority of dischargers to afford the costs of installing and using Best Available Techniques (BAT). Germany and the United States of

[10] They remove potential geographical disparities in the cost of pollution control, within particular industrial sectors. While this may be a desirable characteristic from the regional development point of view, it is not necessarily a desirable characteristic from the environmental point of view.

America are good examples of such countries. However, if a country's economy cannot realistically support the installation of BAT by the majority of its industrial, agricultural, municipal and other sectors, then that country needs an approach that will enable it to prioritise its environmental investments during the period in which its economy develops. The environmentally based approach to setting emission limit values is more appropriate in such circumstances.

It should be noted that a country that establishes an environmentally based approach to setting emission limit values still has the option of introducing technology-based limits at a later stage of economic development.

4.2 The Mass Balance Approach

4.2.1 Estimating Effluent Limit Values based on Ambient Water Quality Objectives

The estimation of Effluent Limit Values (ELVs) based upon surface water quality objectives is based upon a procedure known as statistical mass balance or combining distributions. The procedure has been in use in Great Britain since the late 1970s. It is particularly appropriate to any situation in which ELVs and river quality limit values are expressed in statistical terms. Software programmes are available to perform all of the calculations described here.

A comprehensive description of the mathematical basis of the method is given by Warn and Brew[11]. In its most simplistic form, the method involves the following steps, when applied to the estimation of ELVs for a single point-source discharge that is sufficiently far removed from other discharges not to be sensitive to fluctuations in their quality. If actual data are not available for this calculation, then reasonable estimates should be used, based upon the experience of the competent authority. The calculation is carried out separately for each parameter for which an ELV is required:

- **Step 1**. The statistical distributions of river flow and the concentration in the river of the parameter in question are defined, for the receiving river immediately upstream of the discharge.

- **Step 2**. The statistical distributions of effluent flow and the concentration in the effluent of the parameter in question are defined, for the effluent itself. If the discharge does not yet exist (i.e. if it is only at the stage of being a planning application) then assumed distributions should be used, based upon what can reasonably be expected for the type of discharge in question. For most purposes it is sufficient to assume that all of the flow and quality distributions mentioned above are lognormal. However, in cases where this is clearly not an appropriate assumption (e.g. for intermittent discharges), there is nothing to prevent the user from making some other assumption.

- **Step 3**. Once the distributions have been defined, a series of mass balance calculations are performed, using input flows and concentrations drawn at random from the distributions. For each mass balance calculation, the concentration downstream of the discharge is calculated according to the following formula:

[11] Warn A E and Brew J S (1980): "Mass Balance", Water Research, volume 14, part 10, pages 1427-1434. A Russian translation of this paper has been provided to the Round Table participants in Tashkent. For reasons of copyright it cannot be included in this report.

$$T = (FC + fc) / (F + f)$$

where:

F and C are the flow and concentration upstream of the discharge,
f and c are the flow and concentration of the discharge itself, and
T is the resulting concentration downstream of the discharge.

The calculation is repeated many times[12] to build up a picture of the statistical distribution of downstream concentration. For each iteration, the effluent concentration and the resulting downstream concentration are stored.

- **Step 4.** At the end of this process, the downstream concentration results are analysed in order to determine the concentration that corresponds to the statistic used to define the river quality limit value that is required.

- **Step 5.** The mean concentration in the effluent is then adjusted by an amount calculated to bring the simulated river quality statistic into line with the desired river quality limit value, and the process repeated from Step 3, until the result is deemed to be sufficiently close to the river quality limit value. This defines the concentration distribution required in the effluent, from which the required ELV can then be deduced.

The ELV that is calculated in this way will be the one that will result in the river quality downstream just bordering on non-compliance. The competent authority should then examine the result in the light of three questions:

- Do variations in effluent quality have any significant impact upon the river quality downstream? If the answer is “no”, then it makes sense to adopt an ELV that is consistent with a readily affordable level of treatment. For example, in the Thames region of Great Britain, ELVs of 45mg/l for suspended solids and 30mg/l for BOD (both assumed to be 95th percentiles) are automatically assigned to any sewage treatment works whose effluent flow is relatively small and where the effluent enters a river or stream that provides a dilution greater than 8:1. The rationale behind this is that any reasonably well maintained two-stage biological treatment works should be capable of meeting this standard. More relaxed standards are not used for sewage treatment works, in order to encourage people to regard two-stage biological treatment as the minimum acceptable level of treatment. For industrial or other types of discharge, the criteria may be different, but the same sort of reasoning can usually be applied. This is a good example of an environmentally based ELV being applied only within certain technological limits.

- Does the ambient concentration upstream of the discharge already exceed the ambient limit value required downstream of the discharge? If the answer is “yes”, then a proper review of the catchment is required, taking into account all the other influences on river quality. This will determine whether imposing a strict ELV upon the discharger really is a fair and effective means of regulating river quality, or whether attention should be focused elsewhere in the catchment.

Is the calculated ELV achievable if BAT is used? If the answer is “no”, then it is probably unreasonable to force the discharger in question to bear the cost of installing BAT. This is

[12] Usually in excess of 3,000 times.

another situation in which a wider study of the river catchment is needed, before making a decision.

From this, it is readily apparent that there is no simple rule that can be applied that, if followed, will always give an answer that the competent authority can regard as the required ELV without the application of a fair degree of value judgement, based upon experience and common sense. It is at this point that one needs to consider certain principles of river basin management.

4.2.2 Estimation in the Context of River Basin Management

When is this necessary?

The estimation of ELV for a proposed discharge or for an existing discharge that is undergoing review, is something that cannot always be divorced from other planning considerations within a catchment. While it is certainly true that some discharges can be assessed in isolation from other discharges, there will be occasions on which this is not possible. On these occasions the competent authority should consider undertaking a catchment review.

A catchment review is a planning process in which the competent authority reviews its surface water quality objectives and then determines the most cost-effective and fair way of achieving these objectives. This will take into account the interactions between the various discharges to the catchment and the significance of the proposed discharge in the context of this.

A catchment review is especially important in any of the following circumstances:

- When it is generally agreed that the surface water quality objectives within a catchment need to be reviewed and possibly revised, to take account of significant changes in land use and river water use.

- When some parts of the catchment are failing to comply with their surface water quality objectives and the failure can possibly be attributed to the combined impacts of more than one discharge, or where the reason for the failure is unclear.

- When one or more discharges are failing to comply with their ELVs and these discharges are likely to influence the choice of ELVs for a proposed discharge.

- When that baseline condition of a catchment is not known in sufficient detail to enable basic planning decisions to be made.

- When ELVs are being determined for a major piece of civil infrastructure (e.g. a large regional sewage treatment works) for which public funds will be used, or for a major industry that plays a dominant role in the local economy.

What needs to be done?

The assessment of ELVs for a discharge in the context of a catchment review cannot be separated from the process of catchment review itself. This process will usually involve the following steps:

- Identify all the main features of the catchment. The aim here is not to compile an exhaustive list of the catchment's characteristics, but rather to identify those aspects that are the most significant for the purposes of planning. This will include surface water quality objectives, the locations of the main tributaries, the main discharges and their locations in relation to each other and to the tributaries, the locations at which routine sampling is carried out, and so on.

- Collate existing flow and quality data for rivers and effluents. As far as possible a catchment review should use existing data. It is statistics of flow and quality that are important. These cannot be estimated from short-term sampling programmes and there is, therefore, little benefit in undertaking sampling specifically to support a catchment review. If no routine sampling programmes are in place for the catchment, or if the data that are available cannot be relied upon, then an interim review should be conducted pending the accumulation of at least one complete year's worth of data. The specification of sampling programmes is beyond the scope of this report; nevertheless it is an issue that Uzbekistan does need to address in order to fulfil its policy objectives.

- Get out of the office and look at the catchment. There is no substitute for experiencing first-hand what a catchment is like. Once the reviewer has a broad idea of the catchment's characteristics, he or she should visit all of the most significant locations in order to develop a feel for how the reality matches up to the information that is available.

- Construct an appropriate model of river quality in the catchment. This is discussed further below.

- Conduct a sensitivity analysis. The purpose of this is to decide how sensitive the catchment is to unit changes in ELVs at each of the significant discharges in the catchment. This will indicate which discharges could be possible targets for action in order to address any river quality issues within the catchment. (For example, if this analysis reveals that discharging distilled water from a particular treatment works makes no significant difference to the river quality, then this suggests that investment at that treatment works should be a low priority. On the other hand, if it can be shown that the concentration of investment at a particular treatment works would have major and far-reaching benefits in terms of river quality, then this should be a priority target for investment.) This will also show whether a proposed discharge is sufficiently significant (in terms of its impact on river quality) to justify a more stringent set of ELVs than would otherwise be considered necessary.

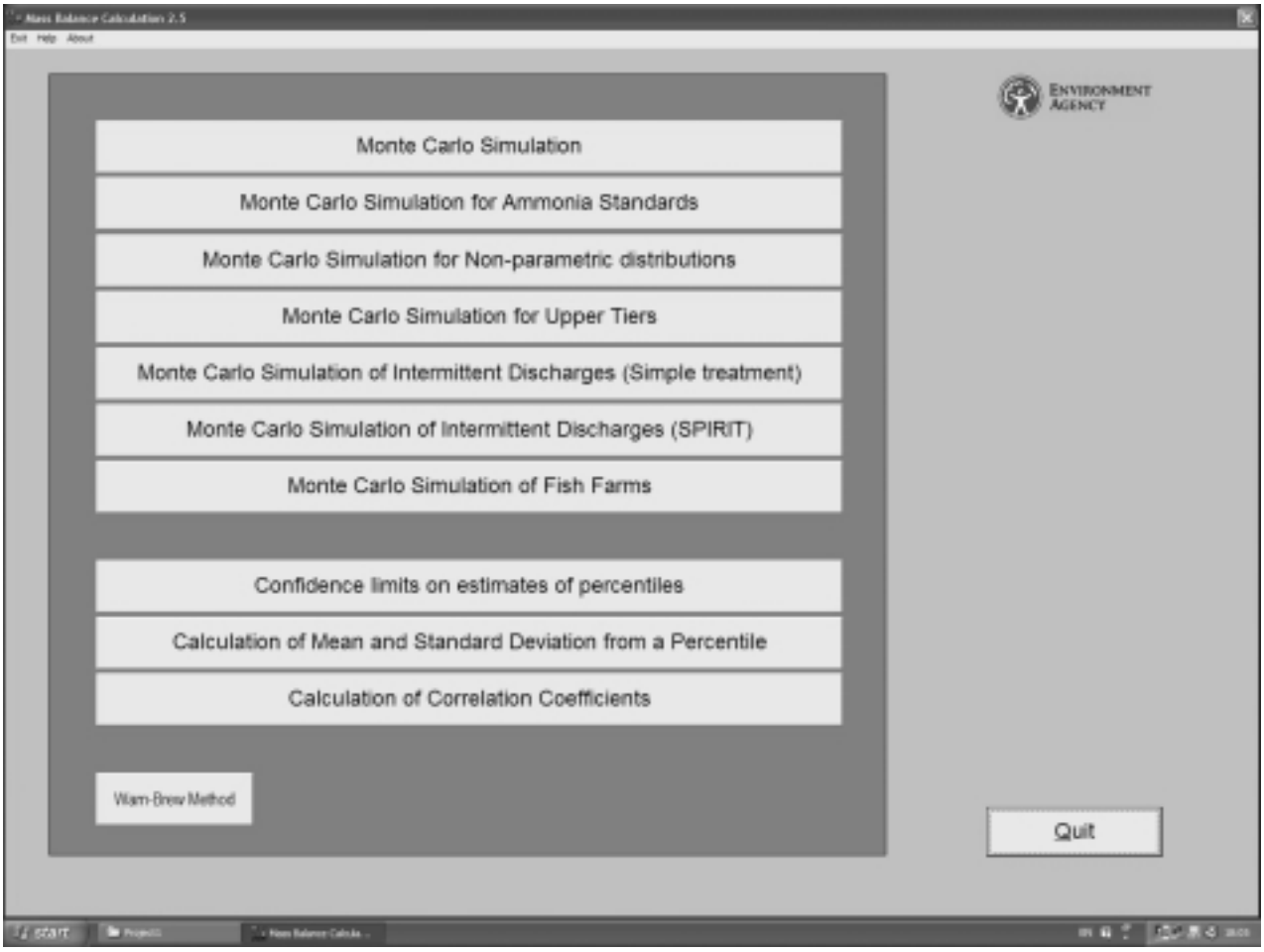
- Design a river quality management scenario. This is an iterative process in which the competent authority designs a linked set of ELVs for the significant discharges in the catchment, designed to meet surface water quality objectives. This should be done in consultation with the various dischargers, to ensure that there is general agreement on the actions to be taken.

4.2.3 Practical Considerations

Computer software tools

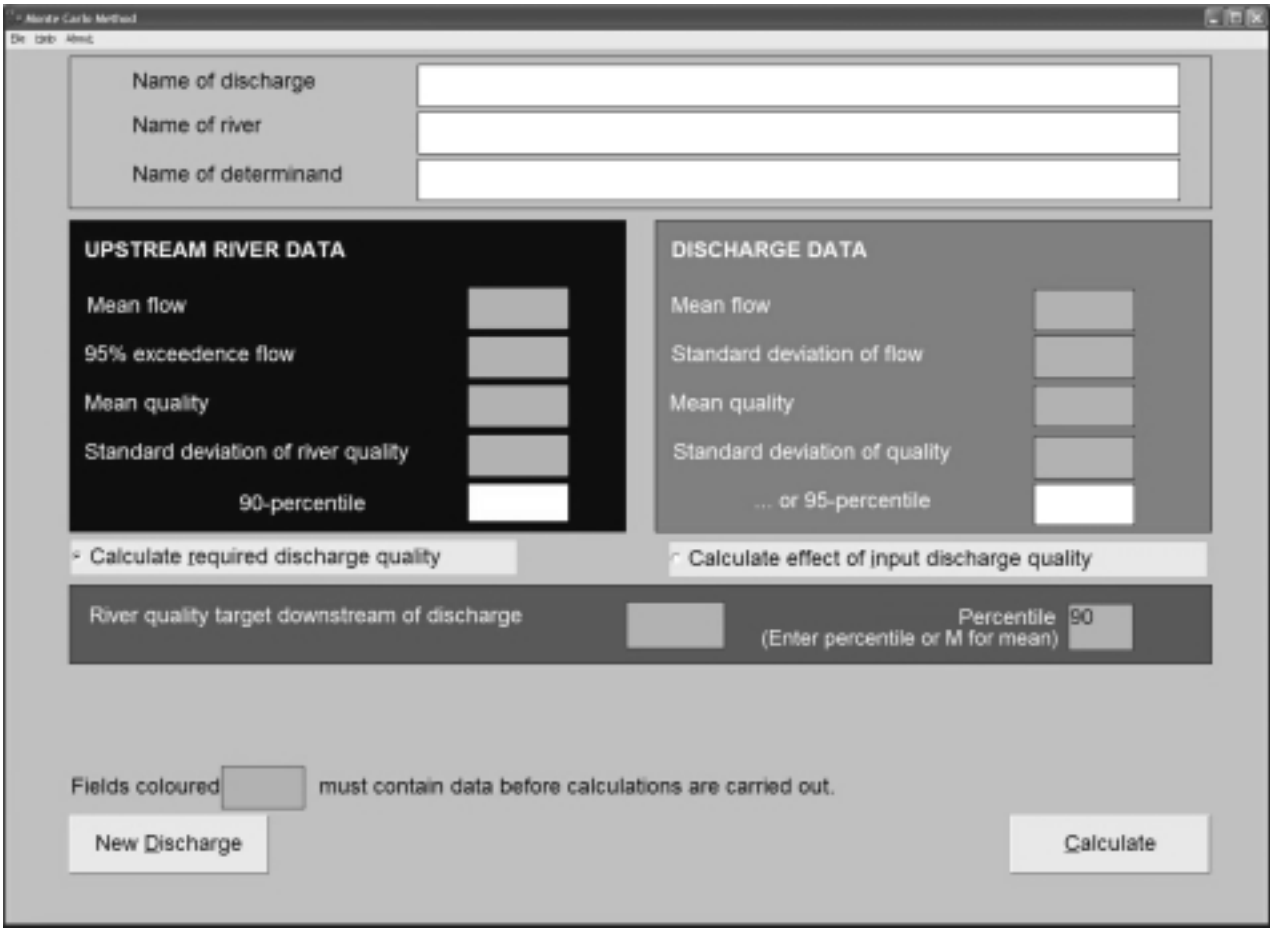
The statistical mass balance calculation that is described in Section 4.2.1 above is routinely performed in the United Kingdom. In cases where the UK Environment Agency wishes to determine ELVs for one particular direct discharge to a river, without altering the ELVs for any other discharges in the vicinity, this is performed using a simple computer program. The purpose of this program is to take all of the input variables that are described in Section 4.2.1 and with this information to perform steps 3 through 5 of that calculation. The result of the calculation is a number that can be used as an indicative estimate of the required ELV for whatever pollutant was the subject of the calculation.

The program will run on any Windows-based PC. It can be installed from the CD-ROM provided here in Annex 8 (the 'Consents' program, item 3[13]). Its main menu screen is shown below, in a Windows XP environment.



The calculation described in Section 4.2.1 is carried out by selecting the "Monte Carlo Simulation" option. This leads the user to the following form, which is used both for entering the primary data and for displaying the result of the calculation.

[13] The writers of this report wish to thank the UK Environment Agency for their willingness to allow this software to be distributed free of charge.



In cases where a more extensive review of ELVs is required in a catchment, possibly involving the option of varying ELVs at more than one location, it is advisable to use a computer-based model of river quality within the catchment. Such a model does not have to be particularly sophisticated: steady-state stochastic models are the most appropriate. (A particularly good example is SIMCAT Version 8, which is routinely used by the United Kingdom's Environment Agency for its simpler catchment modelling problems.) Various authors (e.g. Bowden and Brown, 1983[14]; Brown, 1986[15]) have described the application of such models. These models describe long-term frequency distributions of water quality rather than detailed time series data, and are therefore more appropriate for regulatory purposes than deterministic models.

Calibration and verification are important aspects of model construction. SIMCAT, used by the UK Environment Agency, has a self-calibration option. This is particularly useful where calibration needs to be achieved quickly without recourse to special sampling surveys.

The United States Environmental Protection Agency provides an enhanced stream water quality model to run in a Windows environment (QUAL2E). This simulates the major reactions of nutrient cycles, algal production, benthic and carbonaceous demand, atmospheric re-aeration and their effects on the dissolved oxygen balance. It is intended as a water quality planning tool for developing total maximum daily loads and can also be used in conjunction with field sampling for identifying the magnitude and quality

[14] Bowden K and Brown S R: "Relating Effluent Control Parameters to River Quality Objectives Using a Generalised Catchment Simulation Model", Water Science and Technology, 16, pp 197-206, 1983

[15] Brown S R: "TOMCAT - A Computer Model Designed Specifically for Catchment Quality Planning Within the Water Industry", Water Quality Modelling in the Inland Natural Environment, Paper B1, pp 37-49, BHRA, 1986

characteristics of non-point sources. However, it is not easy to adapt QUAL2E for use in an environment where limit values are expressed in statistical terms. Moreover, QUAL2E is a deterministic model whose input data requirements are probably excessive in the context of Uzbekistan's present situation.

In assessing flow and quality data for rivers and effluents, it is particularly important to pay attention to systematic seasonal variations that may be present in the data. Various software programs are available to assist with detecting such variations (e.g. AARDVARK, used in Moldova in connection with the River Prut studies).

How might Uzbekistan use river quality classes and limit values?

Establishment of a framework for river and effluent quality standards is of no value unless it is applied and used in a sensible way. However, before considering how Uzbekistan might apply such a framework, it is essential to understand and accept one fundamental principle of strategic planning: there is absolutely no point in producing strategies and action plans for river water quality unless the Government of Uzbekistan is prepared to make adequate budgetary provision for the State's responsibilities in regard to the fulfilment of these strategies and action plans. Another way of looking at this is to say that if the State is prepared to allocate only a small budget for river quality planning and management, then it is not realistic to set objectives that cannot be achieved within the limitations of that budget. Strategic planning is about reality and making things happen in reality. It is emphatically not about committing oneself to something that one has no reasonable expectation of achieving.

This fundamental principle provides the key to Uzbekistan's use of the recommendations of this report, because it defines the point from which Uzbekistan must start. Setting objectives that are not achievable will expose the Government or its implementing agencies to the risk of legal action when such objectives are not met.

For planning purposes, Uzbekistan could consider its network of surface water resources to be divided into "river sections". A river section can be a whole river, if the river itself is relatively short (for example, less than 15km), or sub-sections of larger rivers. This will provide flexibility in planning and ensure that planned improvements in the future can be targeted where they are both needed and realistically affordable.

In the short-term, Uzbekistan can afford to spend very little on improving the state of its aquatic environment. Therefore Uzbekistan should assign short-term surface water quality objectives that represent the quality obtaining in its rivers at present[16] and implement a policy of maintaining river quality, with neither deterioration nor improvement (i.e. strict maintenance of the status quo) with respect to the present situation. Each river section should be assigned a short-term quality objective. This is an approach which has been successful in other European countries, including the UK.

In the meantime, Uzbekistan should consider which of its river sections should be prioritised for improvement in the medium-term (without specifying exactly when the "medium-term" will be). Once this has been done, medium-term quality objectives should be assigned to each of these priority river sections.

[16] This should be done by reference to data from the three-year period 1999 to 2002. In cases where data are insufficient, short-term surface water quality objectives should be agreed by consultation with stakeholders. (It is not realistic to require that three years' worth of data must be collected before any decision can be made, because (a) Uzbekistan does not have the resources to do this and (b) there is no justifiable reason for delaying by three years the adoption of short-term objectives.)

For all applications to discharge that are received in the short-term future, ELVs should first of all be estimated on the basis of the short-term quality objective of "no deterioration or improvement". If there exists a medium-term quality objective for the section of river into which the discharge is made, then the competent authority should ask the question, "What would be the incremental cost of treating the discharge in order to achieve the medium-term quality objective?" In other words, what is the difference in cost between achieving the short-term objective and achieving the medium-term objective? The difference in cost is what is known as the "incremental cost", because it is the *increment* that you need to add to the cost of achieving the short-term objective in order to achieve the medium-term objective. The incremental cost should be calculated as follows:

$$incremental\ cost \quad = \quad NPV_m \ - \ NPV_s$$

in which NPV_m and NPV_s are the net present values of the investments needed to treat the discharge to the standards necessary to achieve, respectively, the medium-term and the short-term quality objectives[17]. If, in the short-term, the Uzbek economy is unable to bear this incremental cost, or if the discharger cannot reasonably be expected to bear this incremental cost, then emission limit values should be set and assigned on the basis of the short-term quality objective. At the same time, the competent authority should serve notice on the discharger that the emission limit values will be reviewed periodically with the intention of achieving the medium-term quality objective as soon as it becomes economically feasible to do so. However, in cases where it is realistically possible to finance the incremental cost of achieving the medium-term quality objective, the competent authority should set emission limit values on that basis.

In cases where a discharger cannot afford (or is unwilling to pay) the cost of achieving emission limit values set on the basis of the short-term objective, then the competent authority should address two issues:

- If the quality objective is unachievable as a consequence of problems elsewhere in the catchment, then the discharger cannot reasonably be expected to bear the cost of rectifying this situation. The competent authority should put the application for discharge license on hold pending a full catchment review.

- If the ELVs that the discharger is being asked to meet are both reasonable and economically feasible, then the refusal by the discharger to bear the costs should be construed by the competent authority as grounds for refusing to grant the application.

The application of these principles is demonstrated in Annex 6 on a real case study on the River Wey (Great Britain)

[17] ***Net present value (NPV)*** - The net value or net benefit of a project when all costs and benefits have been discounted to the present at the discount rate. The discount rate is the rate at which future values are discounted to the present.

5 REQUIREMENTS FOR INDIRECT INDUSTRIAL DISCHARGES

The purpose of this section is to consider what standards or Emission Limit Values should be applied to those industrial effluents that are discharged to sewer and which in consequence receive treatment at a municipal sewage treatment plant.

5.1 Existing Situation for Industrial Discharges to Municipal sewers

5.1.1 General Description

Despite of the fact that a lot of industrial enterprises discharge wastewater to the municipal treatment plants, the republic of Uzbekistan has neither unified regulations fixing discharge limits to municipal sewers nor a methodology supporting vodokanals in doing so.

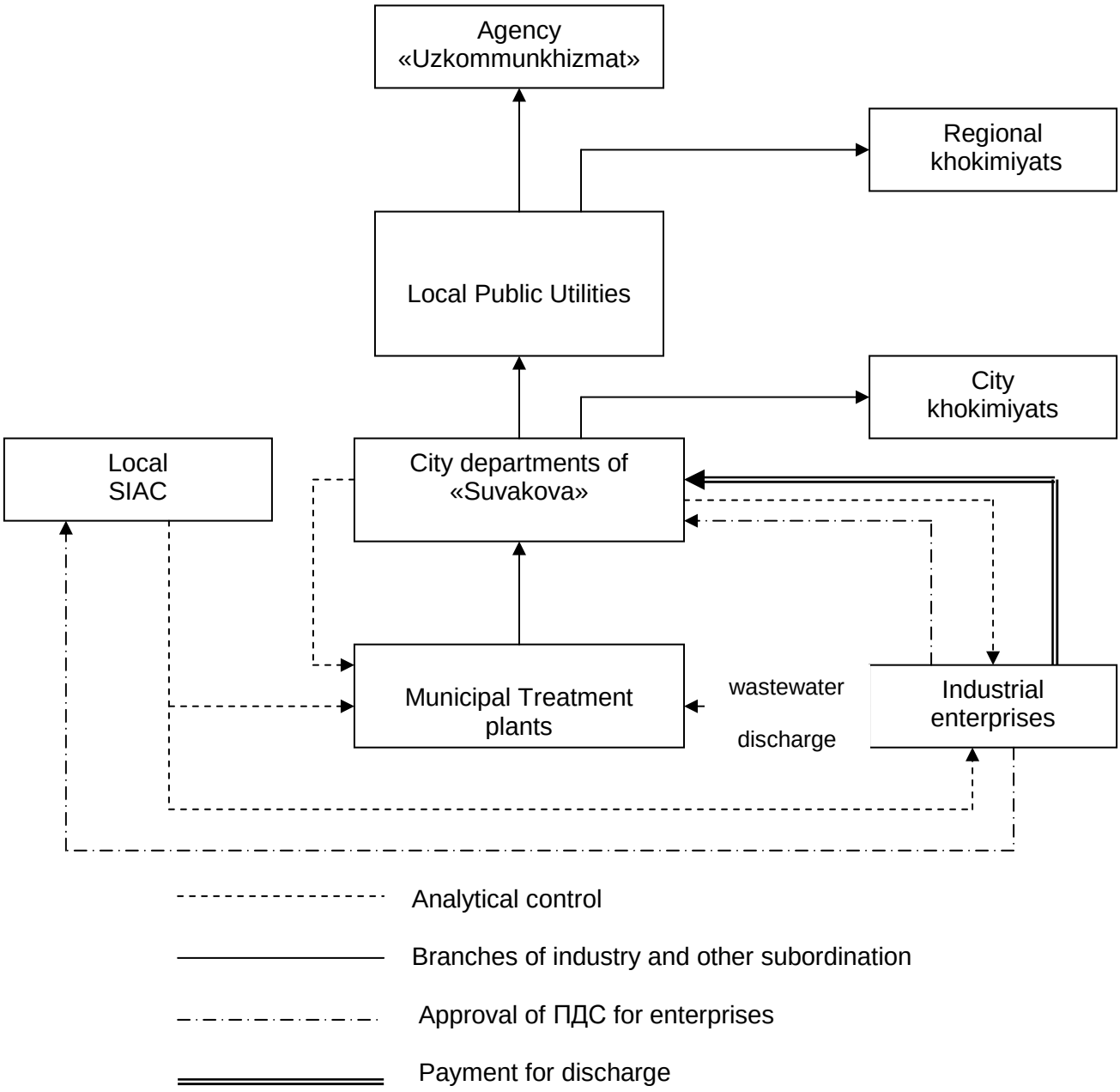
One of the reasons of the absence of guideline documents was the liquidation[18] of the Ministry of municipal services in 2000. It induced that municipal services, including the municipal treatment plants, were transferred under the supervision of regional administrations (khokimiyats). Some of the national responsibilities of the Ministry were transferred to the Agency for Communal Services: "Uzkommunkhizmat" for methodological support and legal developments such as for "elaboration and improvement of tariff policy, water use rates and housing services"[19]. If required the Agency has the right to make decisions and to issue joint legal acts on municipal services together with ministries and authorities of the republic. Further links between all industries are described in the Figure 5.1.

As general methodology has not been worked out at national level, each region has its own approach to define standards for discharges to the municipal treatment plants and to collect the payment related to these discharges. Some vodokanals still use some methods from the soviet time (such as in Almalyk) but their actual application is quite difficult even hazardous.

[18] Decree of the President No. UP-2791 of December 19, 2000 "On further reforms of municipal services system".

[19] Annex 1 to the Resolution of the Cabinet of Ministers No. 74 of February 13, 2001).

Figure 5.1: Links between industries, municipal services and state services



5.1.2 Water quality control

Presently, control over the wastewater discharge of the industrial enterprises to the municipal sewage is made on one side by specialized certified laboratories of the local “Suvakova” (also called vodokanals in Russian) and on the other side by local departments of Specialized Inspections of Analytical Control (SIAC) of the State Committee for Nature Protection.

Laboratories of the Suvakova have the right of 24 hours access to the enterprises controlled. Control over the content of pollutants in wastewater of the enterprises is made once every 2 months in accordance with the lists of water quality indexes approved by local departments of Goskompriroda and SIAC. It implies that there is no unified list of

wastewater quality parameters and the number of parameters varies from 10 to 30 in different regions (for example 12 parameters in Ferghana region, 26 in Almalyk and 28 in Tashkent).

Despite these approved lists, generally the control over the wastewater quality is made only for 5 main parameters such as BOD, pH, suspended solids, ammonia and oil products. In some seldom cases, the content of heavy metals (mainly Cr and Pb) is measured in the effluent of the machine-building enterprises.

This situation is similar to the one identified for direct discharges and is the result of inadequate analytical capability on the part of the controlling laboratories, in terms of a lack of both equipment and qualified personnel.

5.1.3 Risk analysis of indirect industrial discharge

Since usually most of the municipal wastewater treatment plants include primary and secondary biological treatment technologies, some specific industrial pollutants may "disturb" the good operation of these plants. They are mainly the SSAS, oil products and heavy metals since they can influence the activated sludge biocenosis.

High concentrations of SSAS can inhibit and even kill the bacteria whereas these bacteria can treat low concentration of SSAS. Studies about the influence of heavy metals on the development of activated sludge bacteria show that heavy metals have toxic influence; the toxicity of particular metals increases as the oxidation state of the metal increases. Thus, in order of increasing toxicity:

$$Mn < Fe^{++} < Cr < Zn < Fe^{+++} < Pb < Cu < Cd < Co < Hg$$

Main factors affecting the strength of toxic influence of heavy metals on bacterium cells and in particular on active sludge are the concentration of the toxic pollutant and the contact time between the toxicant and the activated sludge.

The third specific factor to be rationed is the content of oil products. Their high concentration in wastewater leads to their absorption by the surface flocks of active sludge, hampering the vital functions of its bacteria and micro-organisms and toxically influencing ferments.

It follows that rationing of SSAS, heavy metals and oil products discharge into municipal treatment plants is necessary to protect the treatment plants' efficiency.

5.2 Recommendation for Standards on Indirect Industrial Effluents

Since Vodokanals are enterprises that discharge industrial wastewater, the rationale of all the previous sections also applies to them. It implies that vodokanals should be subject to the same rules as industries without any exemption on standards or payments.

Since a vodokanal that accepts industrial wastewater is deemed to be fully responsible for treating it to an adequate standard, it follows that the vodokanal should have the responsibility and right to decide:

- Whether or not it is willing to accept the discharge (in other words, the Vodokanal should have the right to refuse to accept wastewaters that it considers might prejudice its ability to comply with its own discharge standards.

- How to regulate those industrial wastewaters that it does agree to accept.

This freedom to act on the part of the vodokanal should be without prejudice to the vodokanal's obligation to ensure that its own final discharge to the receiving water body complies with the national regulation and its licence. That is why this section is designed as "Methodological Recommendations" that could be disseminated by the Agency for Communal Services and not as regulations that should be enforced all over Uzbekistan.

It is worth reiterating that as a consequence of the responsibility described, the operators of municipal treatment plants should have the right to accept or to refuse an industrial effluent, especially if its composition and quality would be prejudicial to the effective operation of the municipal treatment plant.

That is why it is proposed to divide pollutants in indirect industrial discharges into two primary groups[20]:

Group 1: The 'conventional' pollutants that can be faced by conventional municipal treatment (BOD, COD, SS, total ammoniacal nitrogen and phosphate)

Group 2: The 'non-conventional' or critical pollutants, those that have the potential to harm the functioning of the municipal wastewater treatment plant or pose risks for the workers at the plants (heavy metals, certain organic compounds, flammable/explosive/caustic substances and so on).

Rationalizing the pollutants must take into account their toxic influence on biocenosis of active sludge and the pollutants in the sewage entering the WWTP should not exceed maximum permissible concentrations for operation of biological treatment plants (C_{btp}) as described in Table 5.1 for the selected 20 parameters[21].

[20] Like it is currently practiced in the United States of America.

[21] The source of these figures and these maximum concentration for 60 parameters are available in Annex 5.

Table 5.1: Acceptable wastewater quality for biological treatment

№	Pollutant i	Concentration C_{ibtp} mg/l
1	COD	500
2	BOD_5	425
3	pH	6,5-8,5
4	Suspended Solids	500
5	Mineralisation	850
6	Ammonia	2,5
7(8)	Nitrogen	30,0
9	Phosphates (PO_4^{3-})	2,5
10	Ether soluble substances	
11	Oil products	1,0
12	SSAS	20
13	Phenol	0,05
14	Fluorine	1,5
15	Arsenic	0.1
16	Fe 2+	0.5
17	Hexavalent chromium Cr(VI)	0.1
18	Copper	1
19	Zinc	1,0
20	Lead	0,10

5.2.1 Recommendation for 'conventional' pollutants:

One 'equivalent inhabitant' discharges on average per day 200 litres of wastewater that has the following characteristics[22]:

Table 5.2: Average concentrations of pollution for domestic wastewater

Pollutant i	C_{iPop}	
COD	1200	mg/l O2
BOD_5	500	mg/l O2
Suspended Solids	350	Mg/l
Total ammoniacal nitrogen	65	Mg/l
Total phosphorus	20	Mg/l

Source: French Order (6 November 1996) as an application of the decree N° 75-996

Therefore a treatment plant collecting wastewater from a population of P inhabitants and Qi m^3 from industrial wastewater could enforce to the connected industries the Maximum Emission Limit Value C_{imax} for the pollutant (i) so that:

$$C_{imax} * Qi + C_{iPop} * 0.2 * P = C_{ibtp} * (Qi + P*0.2)$$

i.e.

$$C_{imax} = [C_{ibtp}(Qi + 0.2P) - 0.2C_{iPop}P]/ Qi$$

One has to be aware that these calculations are based on average figures whereas C_{imax} should be compelled as a 90^{th} percentile limit, enabling to absorb irregularities and discrepancies between domestic and industrial discharges.

5.2.2 Recommendation for 'non-conventional' pollutants:

For non-conventional pollutants, we are in the situation where $C_{iPop}=0$, therefore the emission limit value to be enforced could be calculated as:

$$C_{imax} = C_{ibtp}(Qi + 0.2P)/ Qi$$

One has to be aware that these calculations are based on average figures whereas C_{imax} should be compelled as a 90-percentile limit, enabling to absorb irregularities and discrepancies between domestic and industrial discharges.

[22] 1^{st} Article of the French Order (6 November 1996) as an application order of the Article 10 of the decree N° 75-996. These figures could be updated with Uzbek real figures.

5.2.3 General recommendations

i. The minimum 8 parameters required to be measured for indirect industrial discharges should be at least the following:

Conventional pollutants	Non conventional pollutants
BOD	Oil products
COD	SSAS (СПАВ);
Suspended Solids	Heavy metals (Fe, Cr6-, Cu, Zn, Pb etc.)
Ammoniacal nitrogen	
PO_4^{3-}	

ii. Control over the general parameters of wastewater, discharged by the industrial enterprises to the treatment plants, must be done by special laboratories of Suvakova and territorial divisions of SIAC not less than:

- Once a month for 'conventional' pollutants and
- Twice a month for 'non-conventional' pollutants (i.e. 24 times a year)

iii. Rationing the pollutants must be made taking into account their toxic influence on biocenosis of active sludge. Concentration of pollutants should not exceed maximum permissible one for operation of biological treatment plants (C_{btp}).

On the base of these recommendations, the Agency of communal services "Kommunkhizmat" proposed to finalise in cooperation with the State Committee for Natural Protection the detailed "Rules of industrial wastewater discharge to municipal treatment plants".

6 WATER PAYMENTS: AN INCENTIVE TO REDUCE WATER POLLUTION

6.1 Existing payments in the water sphere

Existing payments in the water sphere include:

- The payments for water resources pollution
- The claims for damages
- The Penalties

6.1.1 Payments for the pollution of water resources

The introduction of payments for the pollution of water resources was phased in three steps:

Step 1: Beginning from 1992, by the Resolution № 303 (adopted by the Cabinet of Ministers on 29.06.92) introduced payments for over-standard discharges of polluting substances in the environment.

Step 2: The second stage was the introduction of payments for the whole pollution, i.e. for standard and above-standard discharges of polluting substances (Resolution № 554 - 31.12.99).

For implementation of the payments, the Ministry of Finance, the State Tax Committee and Goskompriroda prepared the Instruction № 883 (26.01.00) amended under № 883-1 (26.04.01). Then, by the Resolutions № 500 (26.12.00) and № 490 (31.12.01), the terms of payments were extended to the pollution of the environment. The provisions for calculations of payments were approved on February 15, 2002 under № 1099. Their main features are as follows:

The payers under such type of payments are the juridical persons who discharge polluting substances to water objects (or to the surrounding environment), whatever department they belong to and whatever type of property they own. Nevertheless, the institutions and organizations financed exclusively by the State budget are not obliged to pay. The juridical persons discharging polluting substances to the municipal sewer systems make payment to the vodokanal in accordance with the agreements signed between them. The vodokanals make payments rebated with a 0.1 coefficient.

The total payment for the discharge of the polluting substance (i) is defined by the formula:

$$P = (Mi \times R) + (Mis \times R \times 1.2)$$

Where:

Mi is the mass of the effluents discharged not exceeding ELV (in tons or kg);
Mis is the mass of the effluents discharged beyond ELV (in tons or kg);
Ri is the normative payment rate for the pollutant (i) (Soum per kg or per ton)

The payment rates for 87 ingredients are approved by the Cabinet of Ministers of the Republic of Uzbekistan.

Table 6.1: Example of normative rates applied for pollution discharge in 2002

Ingredient Discharged	Normative Rate (Uzbek Soums / ton)	Normative Rate (USD / ton)
BOD	11535	11
Cadmium	1514318	1442
Oil Products	5424000	5166
Phenol	8162235	7774
NH_4^+	65711	63

* Exchange rate 1USD = 1050 Uz Sums

The amount of payment is calculated by the payers and they are responsible for the correctness of the calculations. If ELVs are not available or in event of expiration of their validity, the coefficient 1.2 is applied on the whole pollution discharged. In this case, the mass of pollution discharged can be estimated on the basis of the technological standard figures.

Juridical persons make the payments by separate payment orders: 80% is transferred to the local budgets (through the State Tax agencies) and 20% to the local Funds for Nature Protection of the SCNP. It is also interesting to note that the application of these payments to 7 case studies[23] showed that the reduction of the payments only on the 20 selected parameters in section 2 cover most of the expected payments.

Such payments do not exempt the payers from the liability to compensate the damage caused by these pollutants.

Step 3: The third stage will be the introduction of payments for irrational and complex use of natural resources with further improvement of the mechanism of payments.

Despite the fact that the total amount of payments for pollution of water resources grows from year to year, its share constituted only 0.005% of the GDP in 2001.

6.1.2 Claims to compensate the damages

In 1983, a procedure was set up to enforce the economic subjects (enterprises, economic entities, farms, etc.) to compensate the damages they make to the environment Today this procedure is controlled by the SCNP. Total amount of claims comes to the local Funds for Nature Protection under the SNCP. The means of these funds should be used for the purposes of creation and implementation of nature protection activities.

In 2002, the SCNP made some claims for 20,108 thousand Sums (i.e. 19,150 USD). As a whole, the claims for violation of laws related to water resources make up in average 30% out of the total sum of claims. As a consequence of such a low level of the application of the claims for damages, such claims induce no incentive for enterprises to improve their practices.

Moreover, there is no appropriate normative and methodological documentation for the application of the procedure. It is required to start with the elaboration of a standard procedure for assessing the damage to water objects and to the national or local economy.

[23] Angren TPS , “Uzmetkombinat” (Bekabad c.), Angren mining enterprises, Novo-Angren TPS , «Tashkent aviation-production unit», Boz-Suy communal treatment plant and Bektemir treatment plant.

6.1.3 Penalties

The responsible executive officials and citizens can be subject to penalty in accordance with the Code of the Republic of Uzbekistan “On Administrative Liability” approved by the Resolution № 2015-XII of the Supreme Council (September 22, 1994) and with the Instructions № 302 “On the Procedure for definition of the administrative liability of the responsible executive officials of Goskompriroda in case of violations in the sphere of environmental protection and nature use” (Ministry of Justice, January 27, 1997).

The minimum wage fixed in the country is taken as a basic rate for calculation of the penalty. Imposition and collection of the penalties for violation of laws in the sphere of nature protection and water resources is implemented by the State inspectors of the SCNP in accordance with the requirements of the laws “On Nature Protection”, “On Water and water use” and the Code of the Republic of Uzbekistan “On Administrative Liability”.

Fifteen percent of the penalties collected are given as an incentive payments (bonus) for the State inspectors and 85% are transferred to the local Funds for Nature Protection.

In 2002, prosecutions were taken against 1943 executive and citizens and 10 210 thousands Soums (9720 USD) were collected. The share of penalties for the violation of laws on water resources amounts in average 20% out of the total penalties. Such a low level of the application of penalties induces no incentive for enterprises to improve their practices. Thus, at present time penalties are not effective tools for nature protection.

Payments made from these different payments to the local Funds for Nature Protection

Table 6.2: Income of payments to the local Funds for Nature Protection (million Soums)

	1999	2000	2001
Total incomes	162.6	213.7	254.0
Including:			
Payments for pollution	124.2	152.6	177.3
Penalties and claims	24.0	43.0	53.9
Others	14.4	18.1	22.3

6.2 Water Related Taxes

6.2.1 The Ecological Tax

The Ecological tax is collected from the juridical persons in accordance with the Presidential Decree “On measures for the tax reforms deepening in connection with the state budget of the Republic of Uzbekistan for 1997” (September 27, 1996). This tax represents 1% from the cost of the output production or rendered services of enterprises. Untill January 2001, this tax income was integrated to the Republican budget. Since, it is allocated to the local budgets in accordance with the Resolution № 500 of the Cabinet of Ministers “On forecasting the main macroeconomic indices and parameters of the State budget of the Republic of Uzbekistan for 2001” (December 26, 2000).

6.2.2 The tax for the use of water resources

The tax rates for the use of water resources are fixed annually by the Resolutions of the Cabinet of Ministers “On forecasting macroeconomic indices and the State budget of the Republic of Uzbekistan”. The Ministry of Finance and the State Tax Committee establish

the procedures for payment on this tax. Tax rate for agriculture use (irrigation) is planned to be introduced in 2003.

Table 6.3: Tax rates for water resources uses (for 1 m^3 in Soums)

	Surface water	Ground water
Enterprises of all sectors of economy	227	292
Power stations	65	292
Municipal service enterprises	125	162
Agricultural enterprises not passed to payment of a single tax for land use	11	14

6.3 Payment for indirect industrial discharge to the municipal sewers

The republic of Uzbekistan does not have unified regulations defining order of calculation and collecting payments from the enterprises for standard and excessive wastewater discharges. Local Public Utilities (local departments of "Suvakova") are responsible for preparing the proposal to reform tariff policy for municipal services (Annex 2 to the Resolution of the Cabinet of Ministers No. 74 of February 13, 2000). The khokimiyats are responsible for approving them.

Despite of the existing differences between different regions, the majority of payments are based on the same approach. As an example let us consider the methods of payment used in Ferghana region. In this region, the amount of the payment for discharge to the municipal sewage should be calculated as follows:

a) The payment for standard discharge is calculated by the formula:

$$P = T \cdot Q_{ф}$$

Where:

T = C + P (Soum)= the average economic tariff per 1 m^3 of wastewater
C is the cost to cover the capital and O&M costs for treating 1 m^3
P is the required profit per m^3.

b) Payment for excessive discharge pollutants is calculated by the formula:

$$P = T \cdot Q_{ф} \cdot \Sigma K_i ,$$

Where:

$Q_{ф}$ is the actual volume of wastewater discharged to municipal sewage (m^3)
$K_i = C_{ia} / C_{is}$ = multiple factor for excessive discharge of the pollutant i.
C_{ia} = Actual concentration of the discharged substance i (mg/l)
C_{is} = Permissible concentration (ELV) for the substance i (mg/l)

c) In case of emergency discharge the payment is calculated by the formula:

$$P = T \cdot Q_{ф} \cdot 10 \cdot K_i$$

Where 10 is a penalty factor;

d) Payment for excess of wastewater discharge limit is calculated by the formula:

$$P = 5 \cdot T \cdot (Q_{ф} - Q_{l}),$$

Where Q_l is the authorised volume of wastewater to be discharged (m^3)

e) If the enterprise, which discharging the wastewater, does not have any permits for ELVs, the total amount of payment is calculated by formula:

$$P = T \cdot 5 \cdot Q_a$$

Where 5 is a penalty factor.

6.4 Expenditures

6.4.1 Self-expenditures by enterprises

Enterprises in RU have to submit every year:

- The statistical report 18-KC on the investments made for protection and rational use of natural resources.
- The report 4-OC on the annual running expenses for nature protection (including the average annual cost for assets and maintenance of nature protection equipment).

Investments amounted 6.1 billions Soums in 2000 (inc. 2.2 billions for water protection). They are covered on average 70 % by the enterprises and 30 % from other sources of financing. Running expenses amounted to 15.5 billions Soums in 2000 (inc. 10.4 billions for water protection) consist from 41 to 84% from the overall expenses for nature protection and are carried out completely by enterprise's means.

In the Permits for Special Water Consumption (PSWC), enterprises have also to describe some plans for nature protection that they should implement within the next 5 years. The SCNP is in charge of controlling that they actually implement them but today, actual monitoring of these plans is very limited and ineffective.

6.4.2 Expenditures from the Funds for Nature Protection

The decree № 246 (24.05.93) defines the rules for formation and expenditures of the Funds for Nature Protection on the base of annual programs approved by the Cabinet of Ministers for the State Fund and by the local Khokimiyats for the local Funds. The planning and control of these programs are facilitated by the Funds' Councils and the management of the Funds are implemented by some special departments.

The Funds for Nature Protection enabled to finance some nature protection activities, scientific researches and preparations of new normative and methodological documentations in the sphere of nature protection.

6.4.3 Expenditures from the State Budget

The State Budget of the RU is formed by the Ministry of Finance, revised by the Oliy Madjlis (Parliament) and approved by the Cabinet of Ministers. Allocation of the budgetary

funds and control over their use are implemented by the Ministry of Macro-economy and Statistic and by the Ministry of Finance.

One State program concern activities on the realization of actions for environmental protection in RU for the years 1999 to 2005.

From 1994 to 1998, the expenses for nature protection activities and operation and maintenance of the existing treatment capacities had increased from 1.7% up to 3% of the GDP. Since then, these expenses reduced down to 0.6% of the GDP. The share of expenses for the protection and rational use of water resources was on average only 0.35% of the GDP.

Availability of insignificant funds for water protection and rational water use caused especially a collapse of wastewater treatment capacities; the number of treatment facilities reduced almost by 3 times since 1994.

The existing situation proves that presently it is more interesting for enterprises to pay for the environmental pollution rather than to pay large investments for nature protection. Meanwhile, the financial means received out of the above-mentioned payments incoming to the funds for nature protection or to local and State budgets were often not used for nature protection activities. Among other figures, it is interesting to remind that about 1.6 billions Soums came to the budgets from the payments for the nature pollution and that the ecological tax collected approximately 50 billion Soums in 2001. Hence the need for developing the mechanisms for targeting the uses of these financial means for nature and water protection activities.

7 RECOMMENDATIONS OF POLICY DECISIONS TO BE MADE

This section draws together the proposals deriving from all of the preceding sections and compiles these into a list of policy decisions to be made.

7.1 Introduction & Pre-requisite

The overall analysis demonstrated that managerial weaknesses are a significant factor in the ineffectiveness of the existing water quality regulating system. The addressing of these weaknesses must therefore be regarded as a priority.

The decisions that we propose to be made in Uzbekistan contain many technical elements that are familiar to Uzbek practitioners. Nevertheless, one has to keep in mind that such decisions will remain undermined if they are not accompanied by a substantial investment in developing management and decision-making skills of the staff. Such effort could be supported among others by the following activities:

i. To train top-level decision-makers of water-related state units in managerial and strategic planning skills;
ii. To give space for flexibility at lower management levels as well as strengthening and clarifying the limits of the statutory framework.
iii. To offer reasonable levels of wages that would enhance staff's involvement and raise interest for professionals to work in state water units.
iv. To enhance the practical and effective application of the existing legislative framework and to train the staff in applying the related standard methodologies.

Practically speaking, the mentioned activities could be implemented as follows:

i. Training should be implemented especially in the high officials' training programs of the Academy of Social and State Management under the President of the Republic of Uzbekistan. The reason of such proposal is that high officials (even if personally invited) usually send some subordinate persons to the training seminars organised by international projects. On the contrary, training sessions in the Academy are made on a regular basis and personal presence of high officials is required and considered to be prestigious. Information received is considered by the participants to be compulsory for execution.
ii. The opportunity for stronger delegation to lower levels of management can be provided by amendments to the Regulations of the ministries and institutions. To start with, the clarification of the limits of the statutory framework could be reached by the allocation of a larger budget for publication (printed copies and CD-ROMs) and free dissemination of decrees and laws.
iii. This can be achieved by combining raising the existing labour remuneration wages with the development of incentives for the good results and work achieved. The list of incentives can be developed taking into account the opinion and wishes of the employees of this sector of economy.

This being said as a pre-requisite for other policy steps, some practical and focused decisions are proposed to be made for the improvement of the system for water quality regulation. These decisions need to be made at national level, the outputs of which need to be given statutory status:

7.2 Policy Decisions to be made

Decision 1: Agreeing the key parameters selected to reflect industrial pollution

It is proposed to select the twenty parameters presented in Table 2.9 as representatives of industrial pollution in Uzbekistan. These parameters would become the minimum but unified ones that state laboratories should be able to measure unified, making the actual monitoring easier, cheaper and shared by all. These lists of parameters have been elaborated with the support of different state bodies working in the water sector and therefore should be acceptable.

It is here proposed to agree that the water permits delivered to industry will focus on a maximum of 9 parameters, taking into consideration the type of industry targeted. Seven main groups of Uzbek industries were identified and parameters characterising the main pollutants discharged by each of this industrial group are proposed in Table 2.8.

Decision 2: Agreeing to river categories to be adopted according to local water uses

As it is unrealistic to expect all water bodies to reach fishery water quality, the scope of this decision is to differentiate the rivers according to the local needs and realistic water uses.

It is proposed to use the two existing categories:

River category 1: Rivers to be used for fishery purposes

River category 2: Rivers to be used for bathing and recreational purposes

And to introduce two new categories:

River category 3: Rivers to be used for extraction of raw water to be treated for drinking water supply also called “potable water”.

River category 4: Rivers to be used for irrigation.

It is understood that when a river (or a section of river) aims to be used for different categories, the category that gives the best water quality will be selected. Each category should be detailed in terms of water user rights and legal constraints. Such description should take into consideration the Government Property Rights on natural resources on behalf of the people and the State (called in Uzbekistan the right of ownership, use and disposal).

This decision also induces mandating a Competent Authority to facilitate the planning of objectives for rivers. This could be done at river basin levels for the main rivers and tributaries of Uzbekistan. The Basin Management Units (BVU) could be appointed as Competent Authorities for this planning.

Goskompriroda should be the body to develop a draft governmental Resolution gathering decisions 1 and 2. Goskompriroda should then submit the draft Resolution for comments and then approval to the interested ministries and institutions: the Ministry of Public Health, the Ministry of Agriculture and Water Management and Glavgidromet (this list can be continued or shortened as per the proposal of the Ministry of Justice). After their official approvals, the Draft should be submitted to the Cabinet of Ministers for ratification.

The document ready for submission to the Cabinet of Ministers should be accompanied with the text on the necessity to adopt the document, with the table of remarks and proposals made by the ministries and institutions. After updating of the document by the "Apparatus" (Secretariat) of the Cabinet of Ministers, the final Draft is can be submitted to the Secretariat for signing by the Prime Minister.

Decision 3: Agreeing to "Water Quality Objectives" for each river category

This decision aims at stating the minimum water quality standards needed to ensure the water uses defined by river categories. They can be seen as Water Quality Objectives to be reached in order to enable the use of water as planned.

It is here proposed to use the concentrations limits presented in Table 3.6. This table was elaborated using existing Uzbek and European standards.

The stress should be put on that the presented standards are expressed **in 90th percentile** whereas current Uzbek practices often apply standards as averages. It follows that at least 90% of water quality measures should show concentrations under these standards. Such change implies modification in the statistical calculations and requires access to raw data (or at least the average and maximum values and the number of samples considered). It also induces that the sampling frequency should be at least once a month.

This decision is in the competence of the Ministry of Public Health (Minzdrav) and Goskompriroda of RU. Water quality standards are established by these authorities independently and do not require approval of any other bodies. However, it is worth to remind this point in the Resolution proposed in decision 2.

Decision 4: Agreeing to a strategy and methodology for regulating effluent discharges.

The proposed strategy for regulating effluent discharges is to appoint to industries effective Emission Limit Values that would enable to reach Water Quality Objectives taking into account the actual quality of the river.

For this purpose, it is proposed to use the support of the mass balance methodology and the following formula:

$$c_{ELV} = [T_{WQO} \quad (F + f) - FC] / f$$

where:

c_{ELV} Emission Limit Values for the industrial discharge expressed in 90th percentile

f is the flow and concentration of the discharge itself

F and C are the flow and concentration upstream of the discharge,

T_{WQO} is the Water Quality Objective (depending on the river category).

Considering the irregularities of statistical distributions, it is not recommended to use the above formula with neither average nor 90th percentiles data. The computer programme "Consents" used in UK could be rather used to integrate statistical variations and therefore towards more accurate estimations[24].

[24] Copies of this programme have been made available to Uzbekistan and a computer copy is available in the attached CD. Some staff of Goskompriroda have also been trained in its use. This programme could be translated

It is essential to understand that the Mass Balance methodology is only a supporting tool. Results coming out of the methodology needs to be analysed according to the reliability of the data provided and the technical feasibility to achieve such quality. In the long-term, this methodology could be extended at the scale of river basins.

The existing document RD 118.0027719.9-91 (№12-137 dated 25.12.91) on "Procedures for elaboration and preparation of the draft standards on Emission Limit Values" should be updated by Goskompriroda as explained in this decision and making the link with the Resolution proposed in decision 2.

Decision 5: Applying the same principles to vodokanals collecting industrial wastewater

Vodokanals accepting industrial wastewater become fully responsible for industrial discharges and must comply with national regulations and their water permits. The water permit allocated to a vodokanal involves same principles as those already applied or described in the previous decision. Vodokanals should be free to accept or reject the effluents of specific industrial dischargers based on failure of those dischargers to comply with permit or other legal or regulatory requirements.

This decision is to be made jointly with Goskompriroda and the Agency for Communal Services. This decision implies that no discount on payments should be made to Vodokanals.

There are no legal obstacles to apply such decision. Therefore this decision is organizational and can be solved either by evolutionary or administrative ways. The evolutionary way requires understanding and cooperation of Vodokanals. The administrative way would induce a statutory order of the Government on such decision.

Decision 6: Supporting vodokanals in managing the collected industrial pollution

Considering the difficulties for vodokanals to manage the industrial wastewater collected, the water permit cannot be considered as sufficient for regulating admissible discharges. Therefore, the Agency for Communal Services could develop (with the support of Goskompriroda and the State Environmental Expertise) a unified methodology to support vodokanals in this task.

It is proposed to separate the pollutants discharged by industries in two groups:

- The 'conventional' pollutants that can be faced by conventional (usually biological) municipal treatment (mainly pollutants from domestic pollution) and
- The 'non-conventional' pollutants that have the potential to harm the functioning of the municipal wastewater treatment plant (mainly SSAS, oil products and heavy metals)

The 90th percentile Emission Limit Value C_{imax} for the pollutant (i) to be accepted by a municipal sewer could be calculated as follows:

$$C_{imax} = [C_{ibtp}(Q + 0.2P) - 0.2C_{iPop}P]/ Q$$

Where:

in Russian.

- P is the number of inhabitants connected to the same treatment plant
- Q is the average volume of industrial wastewater discharged in the municipal sewer per working day (m^3)
- C_{iPop} is the average concentration of domestic wastewater (See values in Table 5.2 for conventional pollutants and $C_{iPop} = 0$ for non conventional pollutants).
- C_{ibtp} is the maximum acceptable concentration that a biological treatment can cope with (see values in Table 5.1)

Such decision requires the State Budget to allocate some specific money to the Agency for Communal Services and Goskompriroda for the finalisation of such methodology and for training Vodokanals in using it.

Decision 7: Improvement of the monitoring and enforcement system

It is proposed to improve the monitoring of industrial pollution on the base of the 20 parameters identified and to unify the related methodology to measure them[25]. This will enable sharing the same parameters and the same quality of data among laboratories all over Uzbekistan. It will especially enable links between the **status** of the water bodies (usually measured by Hydromet) with the **effluents** of industries (usually measured by Goskompriroda). This may create a need to improve equipment and train staff in these common practices. Such costs could be partly covered by the funds for nature protection, since the improvement of monitoring is likely to enhance payments for water pollution.

Self-monitoring by industries should be driven by the Competent Authorities through water permits and specified such that they use the same measuring methodology, with the goal of producing consistent data. The water permit should also compel industries with minimum sampling frequency. In case, those industries cannot measure some of the parameters, they should be allowed to sub-contract agreed private or state laboratories.

It is anticipated that state checks of enterprise data will be implemented to prevent under-reporting and ensure accurate measurement. Independent audits (without warning the enterprise) must be implemented by the state, and fines should be levied or other enforcement actions taken, as appropriate. Independent and reliable state monitoring of volumes and concentrations measured and declared by the enterprises can be seen as a key point for the above decisions to act as incentives.

Such decision does not require any new legal documents. Goskompriroda has indeed the legal right to apply the recommendations made in this decision.

Decision 8: Improvement of the reliability and exchanges of data through the new State Environmental Monitoring System (SEMS)

To promote the implementation of the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan №111 dated April 3, 2002, the State Environmental Monitoring System (SEMS) has been introduced. One of its aims is gathering all water related data from Hydromet, SCNP, The Ministry of Agriculture and Water Resources, the Ministry of Health etc. This initiative should be profitable to integrated water resources management such as river basin management. Therefore, the above decisions and recommendations should be integrated in the present structure of the SEMS.

[25] ISO methodologies could be used for example.

Once again, the concrete result and impact of the SEMS will be driven by the managerial aspects and by the conditions that will rule the exchange of data. As currently practiced in other countries, the SEMS should clearly specify a **Water Sub-monitoring System** in order to prevent dilution of water data in the other environmental themes. The SEMS should not only collect data but should redistribute them to water stakeholders. Free access to raw data for all members of the SEMS is a minimum condition to be set-up. In one way or another, data providers should find their interest and see practical results in providing data.[26]

Such decision could be formulated in a directive document and approved by the stakeholders of SEMS. Such document should have a methodical character and appoint Goskompriroda responsible for collection, exchange and dissemination of the information received in the result of monitoring. Such document must be examined and registered by the Ministry of Justice.

Decision 9: Upgrading the payments on wastewater as an incentive to reduce water pollution

The proposed licensing and monitoring systems will become a real incentive to reduce water pollution only when it is linked to enforcement of water payments for the pollution discharged. The four existing types of payments (payments for water use and pollution discharge, the ecological tax, fines and claims) are a good start for such enforcement. Its effectiveness could be enhanced with the following improvements:

Sub-decision 9.1: Unifying the payments between industries and vodokanals

All industries and vodokanals should undergo the same level of payments. There is no environmental rationale for exemption of state enterprises or for 90% discount for Vodokanals. Without such decision, every industry has more incentive to discharge its effluents through municipal sewers, enhancing the risk of hampering the good functioning of municipal wastewater treatment plants. Institutions and organizations financed exclusively by the State budget should also be obliged to pay.

Compelling the same payment for all enterprises and vodokanals of Uzbekistan could be done in the Resolution mentioned in the Decision 2.

It could also be recommended to Vodokanals to collect at least the same payments as the industry would pay if it would discharge its effluent directly to water bodies.

Sub-decision 9.2: "Water pays for water": The money collected from water payments will be reused for funding or subsidizing effective water protection activities

One incentive for acceptance by industries of the various decisions proposed herein is allocation of the money collected from water payments to effective water protection activities[27].

[26] Example of such Unified database is the French National Water Database (RNDE) which can be accessed on www.rnde.tm.fr

[27] For that purpose, clearer definitions of "Water Protection Activities" should be introduced. For example, the rehabilitation of drinking water supply should not be included in such activities.

The principle is to target in priority the high polluters in order to increase the return on the expenditures made. Such actions demonstrate how effective the money collected from water payments is spent and enhance the public and political impact of such decisions. By seeing the results or by receiving-back some of the money paid as subsidies for reducing their pollution, both industries and vodokanals will be more ready to pay the water taxes.

It implies that sate units develop their planning capacities, identifying the hot pollution spots and proposing cost effective solutions to tackle them.

Such decision to target the use of the money collected from water payments could only be applied if 100% of the water payments would be transferred to the local and State Funds for Nature Protection. In order to implement this sub-decision, the regulation of the Environmental Funds should be amended in order to make the process of expenditures targeted for water protection activities. The amendment should also stipulate the right of the Fund Councils to take independent decisions on granting the subsidies.

International current practices try to cancel such environmental funds, pointing out their poor management. Nevertheless, it has to be stressed out that such funds in France demonstrated a very high efficiency over the last 30 years through payment of water fees to the River Basin Funds. It acted as both an incentive and a revenue-raising tool, enabling the application of the “Water pays for Water” principles. That is why, the Project recommends Uzbekistan to develop the existing Funds strengthening the related management and institutional framework towards efficiency. Even if many other international projects recommend such funds to be cancelled in the NIS, the Project believe that such funds could be properly handled in Uzbekistan with the necessary reforms and capacity building of the Funds’ managers.

It is also understood that the higher part of water payments lay within the 1% ecological tax. Therefore the proportional part linked to water (certainly between 25 and 30%) should be tracked as well for funding such activities. Another alternative could be to cancel this tax by amending the Tax Code and to increase accordingly the rates for the pollution of water resources.

Sub-decision 9.3: Reducing the number of pollutants submitted to payments

The number of parameters used for the payments for water pollution could be reduced from the existing 87 to the 20 parameters mentioned (and may be a few others for bacteriological pollution). There is no point in charging for some pollutants that cannot be measured by the state control laboratories.

Such decision would induce raising the existing rates per tons of pollution discharge in order to compensate the “losses” which may occur by giving up some of the parameters.

Sub-decision 9.4: Rising the level of payments so that Industries and Vodokanals would rather improve their wastewater treatment facilities than paying the taxes.

Today in Uzbekistan, the payments for the pollution of water resources represent 0.001% of the GDP. Because of such low level of payment, it is still today more interesting for an enterprise to pay the taxes and fines rather than reducing the water pollution discharged. That is why the level of payments should be raised to reach rates that would raise real incentives for the enterprises to invest some money in the rehabilitation and in the operation and maintenance of effective treatment plants.

The level and the frequency of fines for non-authorized and over-standard discharges need also to be strengthened. Considering that 6 million sums were collected as fines in 2001, one can see that either the level of fines is too low or the control over enterprises is weak. The same comment stands for claims for damages (15 millions Sums collected last year).

In case such raise is not acceptable or affordable for enterprises, it is then recommended to lower the ecological tax (for example to 0.85% of the output production) and to report its equivalent weight on the rates for pollution discharge. That would clearly enhance the "polluter pays" principle whereas the existing ecological tax does not make any links with the pollution discharged.

For the implementation of sub-decision 9.3 and 9.4, the appendix N°20-3 of the Resolution N°490 (31.12.01) should be modified.

Decision 10: Enhancing flexibility through river basin planning and participation of water stakeholders

The best incentive for industries and other water stakeholders is certainly to participate in the decisions that will influence their future. They are indeed more ready to accept some decisions when they had been involved in their development. That is why river basin is an appropriate scale to which it possible to gather both decision makers and water users. River Basin Planning enables to take into consideration the discrepancies between different basins, avoiding compelling some national planning or strategies that would not match with regional disparities.

As mentioned before, river basin planning also enables to identify the main water pollution problems and to propose the most cost-effective solutions to improve them.

The flexibility in the planning process should then be balanced by compelling its outputs (objectives and action plans) as statutory.

The participation of the water representatives should be organised with clear decision-making procedures to be approved by the Government (ideally through amendment to the Law "On water and water use").

7.3 Guidelines for completing the Policy Package

This section is linked with the Activity 10i(7)[28].

In the medium term, Uzbekistan needs to develop an overall policy package to achieve its goals with regard to water quality. The proposals contained in this report, if implemented, would be a key component of such a policy package. These proposals link to a number of other policy instruments that could be developed by the Government. In this section, we consider what are these other policy instruments and what is their function. The list provided is not intended to identify all of the linkages that exist. However, it highlights the

[28] The intention here is to provide the Uzbekistan Government with complementary information to plan future activities aimed at developing additional policy packages and sub-packages that link into the package developed in this project. In other words, these are Terms of Reference for the Uzbekistan Government, not for consultants.

more important ones that Uzbekistan should seek to address in the short- to medium-term:

- *Incentives to reduce domestic pollution*. As initially designed, the present package covers the links between industrial activities and water quality. Therefore the same approach could be applied for domestic pollution. The new indicators that would be introduced would be mainly bacteriological ones.

- *Measures for the control of non-point sources of pollution.* Diffuse sources of pollution are a significant factor in determining the quality of Uzbekistan's rivers. In order to have a reasonable expectation of complying with its own surface water quality objectives, the Uzbekistan Government must bring these diffuse sources under control and regulate them effectively. This could include introducing codes of conduct for agriculture, increasing the percentage of the rural population served by effective sewerage and sewage treatment, legislation to regulate the handling and disposal of municipal wastes, and so on.

- *Measures for the control and optimisation of the quantity of water used.* Water quantity is also a main issue in the water sector in Uzbekistan. A clear policy to tackle the lack and misuses of water resources needs to be developed. The Economic Instruments should also develop incentives for water savings and rational use of water resources.

- *Institutional structures and procedures for integrated river basin management.* River basin management, as a concept, does not always have to be applied to river basins at the macro scale. It can equally effectively be applied to small tributary sub-catchments and in fact can be more effective when used in this way.

- *Measures for the overall regulation of water use.* This will include all aspects of licensing and permitting, to which the proposals described in this report will contribute. It will also include the regulation of river hydrology. Therefore this is a particularly important component in the context of protecting the Aral Sea.

- *Monitoring*. Uzbekistan will need to develop a coherent monitoring programme that is achievable within the constraints of available laboratory analytical capability and resources, and that optimises the deployment of these available resources with respect to the regulatory value and statistical quality of the information obtained. Systematic methods have been developed for such purposes in the European Union, some of which have been developed into commercial software packages.

- *Enforcement*. Uzbekistan needs to develop a set of measures for the enforcement of water quality controls and more generally of environmental legislation as a whole. The purpose of these measures is to ensure that the different actors fulfil their statutory obligations. The measures will relate not only to ensuring that polluters and water users abide by the terms of their water permits, but also to ensuring that the competent authorities fulfil their obligations to Uzbekistan's public in a rational and effective manner.

ANNEXES

Annex 1: Logframe planning matrix for Uzbekistan (sub-task 10i)			
Wider Objectives	Indicators of Achievement	How, When and By Whom Indicators Will Be Measured	Assumptions and Risks
The wider objective of the Uzbekistan sub-project is to undertake the first phase in the development of a policy package aimed at providing increased incentives to industry to reduce water pollution. This first phase will consist of identifying the upstream linkages to environmental water quality standards, proposing reforms to the framework of these and deriving the primary data needed to link this into the next stage of the taxation reform.	Completed preparation of policy sub-package report.	On presentation of the policy sub-package report. On completion of the sub-project, by audit conducted by the Tacis Monitoring Team.	Project partners support the sub-project. Contractor's team remain flexible in regard to deployment dates.
Immediate Objectives	Indicators of Achievement	How, When and By Whom Indicators Will Be Measured	Assumptions and Risks
The immediate objective of the country sub-project is to prepare a policy sub-package that includes at least the following elements:			
A set of key environmental water quality parameters for which it would be appropriate to set standards in order to provide increased incentives to reduce industrial pollution.	Ambient water quality parameters identified.	List of parameters included in policy sub-package report, as verified by Tacis monitoring team.	No significant risks.
A revised set of standards for the environmental parameters that are identified, with an indication of the possible linkages between each standard and corresponding incentive mechanisms.	Set of standards produced. Standards demonstrated to be in harmony with international norms.	Standards included in policy sub-package report, as verified by Tacis monitoring team.	Project partners accept use-based categorisation of ambient water quality. Uzbekistan aims for EU standards.
A set of clear and readily applicable methods for calculating discharge quality standards for direct industrial and municipal wastewater discharges, based upon the set of ambient environmental standards that is developed.	Methodology identified and described. Application of the methodology demonstrated by worked examples.	Methodology included in policy sub-package report, as verified by Tacis monitoring team.	Uzbekistan willing to accept standards that are not based on 'zero risk'.
A set of clear and readily applicable criteria based upon effluent quality and municipal wastewater treatment considerations, for deciding how indirect industrial effluents should be handled.	Criteria recommended.	Criteria included in policy sub-package report, as verified by Tacis monitoring team.	No significant risks.
Terms of Reference for the Phase II policy sub-package.	Terms of reference produced.	Terms of reference produced and delivered to project partners, as verified by Tacis monitoring team.	No significant risks.

Outputs	Indicators of Achievement	How, When and By Whom Indicators Will Be Measured	Assumptions and Risks
Activity 10i(1) A clear and concise list of water quality parameters for each type of industrial discharge and for municipal discharges that might contain indirect industrial discharges.	List present in the policy sub-package.	Policy sub-package to be made available upon request to the Tacis Monitoring Team, October 2002.	Project pqrtners agree the scope of the policy package.
Activity 10i(2) A decision flowchart that will be used by the sub-project team to guide its own working.	Flowchart produced.	Flowchart to be available upon request by Tacis Monitoring Team, from end May 2002 onwards.	Conditional upon output from 10i(1). Otherwise no significant risks.
Activity 10i(3) A set of ambient water quality standards oriented primarily towards the control of industrial pollution, grouped according to different categories of ambient water use.	Ambient water quality standards present in the policy sub-package.	Policy sub-package to be made available upon request to the Tacis Monitoring Team, October 2002.	Conditional upon output from 10i(1). Otherwise no significant risks.
Activity 10i(4) A set of proposals relating to the calculation of effluent discharge standards.	Proposals present in the policy sub-package.	Policy sub-package to be made available upon request to the Tacis Monitoring Team, October 2002.	Conditional upon output from 10i(1). Assumes that: Uzbekistan willing to consider computer-based methods.
Activity 10i(5) A set of proposals relating to the discharge quality criteria that should be used as the basis for deciding how to handle indirect industrial effluent discharges.	Proposals present in the policy sub-package.	Policy sub-package to be made available upon request to the Tacis Monitoring Team, October 2002.	No significant risks.
Activity 10i(6) A Phase I policy sub-package report, in English and Russian.	Policy sub-package report produced.	Policy sub-package to be made available upon request to the Tacis Monitoring Team, October 2002.	No significant risks.
Activity 10i(7) Terms of Reference for the Phase II policy sub-package.	Terms of Reference produced.	Policy sub-package to be made available upon request to the Tacis Monitoring Team, October 2002.	No significant risks.

Inputs			
Contractor's staff and resources. Project partners. Other stakeholders, to be identified.			

Annex 2: Laws and Decrees adopted by the Government of the Republic of Uzbekistan in the field of state regulation of water resources consumption and protection.

1. Laws of the Republic of Uzbekistan
   1.1 "on nature protection" 09/12/92
   1.2 "on water and water consumption"

2. Decrees of the Government of the Republic of Uzbekistan
   2.1 Regulations on water protection zones of reservoirs and other water bodies, rivers and main canals and collector drains as well as on sources of drinking and communal water supply, medical and health recreation assignment of the Republic of Uzbekistan" 07.04.92
   2.2 " on limited water use in Uzbekistan" 03/08/93
   2.3 "on establishing the charges for over quota effluents of contaminating substances to the environment and wastes allocation." 29.06.92
   2.4 "on forecasting the basic macroeconomic indicators and state budget of the Republic of Uzbekistan for the year 2000", 31.12.1999

3. Normative acts of State Committee for Nature Protection of the Republic of Uzbekistan (GosKomPriroda)

   3.1 Instructions on agricultural damages caused by contamination of ground water" PD 118.0027714.47-95
   3.2 "The order of working out and registering the project of Maximum Admissible Effluent of contaminating substances, released by sewage water to the water objects" RD 118.0027719.5-91
   3.3 " Order of issuance the special permission for special water consumption" RD 118.0027714.6-92
   3.4 "Temporary methodological recommendation for exercising control over the ground water protection in the Uzbekistan", State Committee for Nature Protection and Uzbekhydrogeology R.Uz, T. 1991
   3.5 " Order of working out and basic requirements for the recommendations on sewage water consumption for agricultural irrigation." RD 118.0027714.41-94

4. Standards and normative documents on sewage water flow control and management

4.1 Normative documents on water resources protection

Main documents

Methodology of laboratory control over the measuring quality of sewage composition dimension , RD 1.01.808.7.3-88, NIIVO, Ministry of melioration and water management of USSR, 1988

Draft, order of working out, considering and approval of schemes protection and rational consumption of water resources of small rivers, RD 33.1.1.02-90, VO "Soyuzvodproject", Minvodstroy USSR, 1990

Methodic instructions on biological testing of water, RD 118.02-90, GosKomPriroda USSR, 1991

Nature protection. Hydrosphere. Internal and external control over the precision of measuring of sewage composition. Order of execution, RD 118.3897485.23-94, GosSIAK GosKomPriroda R. Uz.

Nature protection. Hydrosphere. Recommendation on decreasing the water consumption and reduction of sewage water effluent by enterprises of cotton, knitted fabric and silk branches of light industry, RD118.0027714.44-95, TashNII “VodGeo”, GosKomPriroda, R.Uz, Decree №23-TK from 12.09.95

Nature protection. Hydrosphere. Working out the technical solutions on protection of water objects from throws of biogenic elements, RD 118.002 7714.48-95, TashNII “VodGeo”, GosKomPriroda, R.Uz, 05.12.95

Nature protection. Hydrosphere. General requirements for quotation of sewage water thermal contamination, RD118.002 7714.46-95, Bugayev SANIGMI, Decree of GosKomPriroda № 26-TK from 30.04.96

Nature protection. Hydrosphere. Discovery the causes of breach of processes of biological cleaning of sewage water and working out measures on its elimination,
RD 118.002 7714.49-95, TashNII “VodGeo”, GosKomPriroda, R.Uz, № 76 from 18.06.96

Nature protection. Hydrosphere. Methodic of quotation of thermal contamination of water and determination of charges for thermal contamination of water objects,
RD 118.002 7714.57-96, , TashNII “VodGeo”, GosKomPriroda, R.Uz, № 34-TK from 23.06.97

Instructions, recommendations and other documents

Increased amount of water consumption and sewage flow for different branches of industry, SEV, VNII, VodGeo, 1982

Water sources of Uzbekistan and its protection, B.Boder, I.Ilyinskiy, “Uzbekistan”, 1982

Instructions, classifications of contaminating sources of water objects,
HBH 23-5.3.03-85, MinVodHoz, USSR, 1985

Recommendations on carrying out the effective hydrobiological control in oxygen purification plants , with aero-tank, SANTI, MinVodHoz USSR, 1987

Recommendations on carrying out technological and hydrobiological control in biological filters, MinVodHoz USSR, 1987

Rules on receiving the industrial sewage water and sewerage system of populated areas, Ministry for communal services of Uzbekistan, 2001

Rules on surface water protection, GosKomPriroda, USSR, 1991

Methodic instructions

Methodic of evaluation the work efficiency of urban sewerage purification plants, MinJilKomHoz, MinVodHoz USSR, 1990

List of certified methodic which are temporary admitted for use on determination of composing components in natural and sewage water, GosSIAK GosKomPriroda R.Uz, 20.01.1997

4.2 Documents on economy and consumption of nature use

Directive documents

Nature protection. Methodic instructions on determination of charges for throws, throws of contaminating substances in the nature and allocation of wastes,
RD 118.0027714.19-92, NIPTI “Atmosphere”, GosKomPriroda R.Uz, № 7-TK from 16.11.92

Nature protection. Instruction on order of carrying out the evaluating of influence on the environment during the square selection, working out technical- economic grounds and construction projects (reconstruction, expanding, rearming) of economic objects and complexes, RD 118.0027714.24-93, Main State Ecological Expertise under GosKomPriroda R.Uz, № 37 from 28.07.93

Nature protection. Instruction on the order of carrying out the evaluation of anthropogenic influence on the environment, RD118.0027714.52-95, NIPTI “Atmosphere”, GosKomPriroda R.Uz, № 73 from 16.05.96

Regulations

Regulation on the funds for environment protection, GosKomPriroda R.Uz, Decree of Cabinet of Ministers of R.Uz № 246 from 24.05.93

Methodic for determination of tariffs for irrigating water, A. Korgunov Engineering-irrigation Institute, MinVodHoz USSR, 1990

Instructions on the order of accounting the payments for over quota effluents (effluents, wastes allocation) of contaminating substances in the environment of the Republic of Uzbekistan under the forms №1-effluents, №2 effluents, № 3-effluents, GosKomPriroda R.Uz, Order № 77 from 27.07.92

Instructions on the order of calculation of payments for over quota effluents of contamination substances from movable sources, GosKomPriroda R.Uz, 1993

Instruction on interaction of prosecution offices with bodies of State committee for nature protection and on the order of registering and transfer the materials on facts of infringement of environmental legislation, GosKomPriroda R.Uz and Prosecution Office of R.Uz, 1995

On reducing the taxation base till 30 % of costs of carrying out the environment measures, Ministry of Finance of R.Uz, State taxation Committee of R.Uz, 1997

List of standards and directives of the Republic of Uzbekistan, intergovernmental and international and sectoral standards on nature protection

State standards of the Republic of Uzbekistan

Nature protection. Hydrosphere. Classification of waters, GOST 17.1.1.02-77

Nature protection. Hydrosphere. Classification of water consumptions, GOST 17.1.1.03-86

Nature protection. Hydrosphere. Classification of underground water upon the aims of water use, GOST 17.1.1.04-89

Nature protection. Hydrosphere. Criteria and indicators of water quality for irrigation purposes, GOST 17.1.2.03-90 (ST SEV 6457-88)

Nature protection. Hydrosphere. General requirements for the protection of surface water from contamination, GOST 17.1.3.13-86(ST SEV 4468-84)

Nature protection. Hydrosphere. Hygienic requirements for zones of water objects recreation., GOST 17.1.5.02-80

Drinking water. Hygienic requirements and control of the quality. GOST 2874-82

Water of economic- drinking assignment. General requirements for field methodic of analysis, GOST 24902-93

Water quality. Terminology and definitions, GOST 27065-86

Standards and rules

Hygienic and sanitary-technical requirements to the sources of centralized economic-drinking water supply of population. Selection rule, SanPiH 0025-94

Sanitary standards and radiation security rules, SanPiH 0029-94

Sanitary rules and standards of protection of surface water from contamination, SanPiH 0056-96

Installation of solar hot water supply, KMK 2.04.16-96, Instead of VCH 52-86

Water supply. Outside networks and plants, KMK 2.04.02-97, instead of SniP 2.04.02-84

Sewerage. Outside networks and plants, KMK 2.04.03-97, instead of SniP 2.04.03-85

Annex 3 List of parameters to be controlled in surface and ground water and in sources of contamination (GosKomPriroda)

Code	Indexes	Code	Indexes
1	Aceton	41	PH
2	Ammonia	42	Phenol
3	Ammonium nitrogen	43	Phosphates
4	Antimony	44	Potassium
5	Arsenic	45	Rodanids
6	BPK 5	46	Smell
7	Cadmium	47	SSAS (SPAV)
8	Calcium	48	Strontium
9	Caprolactam	49	Sulphates
10	Celen	50	Sulphur-carbon
11	Chlorides	51	Suspended particles
12	Chronium	52	Tastes
13	Cobalt	53	Toluol
14	Coli-index	54	Tungsten
15	Colititre	55	Turbid
16	Colors	56	Vanadium
17	Copper	57	Vismut (Bi5+)
18	Cyanides	58	Zinc
19	DDT		
20	Diluted oxygen		
21	Electrical conductivity		
22	Ether -diluting substances		
23	Fluorine		
24	Furfurol		
25	Hardness		
26	HPK		
27	Iron		
28	Lead		
29	Magnum		
30	Manganese		
31	Mercury		
32	Methanol		
33	Mineralisation		
34	Molybdenum		
35	Natrium		
36	Nickel		
37	Nitrate nitrogen		
38	Nitrite nitrogen		
39	Oil products		
40	Oxidizing		

Annex 4: Types of industries described in the SEV Manual: "Integrated standards of water consumption and water flow for different industrial branches".

1. Fuel industry
   A. *Coal and shale enterprises*
   B. *Enterprises of the peat industry*

2. Industry of Heat and power engineering

3. Black metallurgy
   A. *Mining manufacturing*
   B. *Metallurgical factories and workshops*

4. Non-ferrous metallurgy

5. Oil-gas industry
   A. *Oil industry*
   B. *Gas Industry*

6. Oil-refining and petrochemical industry

7. Chemical industry
   A. *Mining-chemical works*
   B. *Manufacturing of basic chemistry*
   C. *Nitrogen industry*
   D. *Production of Chorine and Organic compounds*
   E. *Enterprises of paintwork industry*
   F. *Organic intermediate products and stuffs production*
   G. *Plastics and phenol production*
   H. *Chemical fibers production*
   I. *Production of air separation products*
   J. *Photographic industry*

8. Timber, wood, resin and hydrolytic industry
   A. *Sawmill, woodworking workshops and factories furniture factories*
   B. *Resin productions*
   C. *Hydrolytic factories*

9. Pulp and paper industry
   A. *Productions of wood-pulp, cellulose, semi-cellulose, paper and cardboard*
   B. *Processing of waste products of sulphate-cellulose production*

10. Consumer goods industry
    A. *Enterprises of preprocessing flax ,hemp, wool, silk*
    B. *Enterprises of fiber production*
    C. *Enterprises of knitting, stocking and clothing industry*
    D. *Leather-shoe enterprises*
    E. *Fur and bumping enterprises*

11. Grain-processing, baking, meat and milk, fishery and food industry
    A. *Enterprises on keeping and processing grains*
    B. *Enterprises of baking and vegetable-cans industry*
    C. *Enterprises of milk industry*
    D. *Enterprises of meat industry*
    E. *Enterprises of trade fishery, fish reserves reproduction and fish-processing industry*
    F. *Enterprises of fat and oil industry*
    G. *Enterprises of fragrance-cosmetic industry*
    H. *Enterprises of sugar industry*
    I. *Enterprises of wine, brewing trade, alcohol, alcoholic-beverage, food-acid industry, juices, beverages and nutrient yeasts*

12. Engineering industry

13. Electrical industry

14. Construction industry
    A. *Manufacturing of non-metallic building materials*
    B. *Manufacturing of cementing building materials*
    C. *Enterprises of sanitary-technical equipment*
    D. *Glass work*
    E. *Manufacturing of soft roofing and hydraulic insulating materials*
    F. *Manufacturing of concrete products and construction*

15. Other industrial branches

Annex 5: Admissible concentration of pollutants for biological treatment

№	Pollutant	Concentration, mgl
1	2	3
1	Aluminum	0,75 (П)
2	Aniline	2,57 (П)
3	Acetaldehyde	8,58 (П)
4	Acetone	17,16 (П)
5	Barium	0,44 (ПМ)
6	Benzoic acid	5,43 (П)
7	Vanadium (quinquivalent)	0,1 (П)
8	Bismuth	15 (П)
9	Glycerin	38,6 (П)
10	Chloric iron	5,0 (П)
11	Sulphuric iron	0,5 (П)
12	Adipose and vegetable fat	5,0
13	Cadmium	0,1 (П)
14	Caprolactam	10,73 (П)
15	Cobalt	0,1 (П)
16	Xylol	1,0 (П)
17	Sulphur dyes	10,7 (П)
18	Manganese	30 (П)
19	Molybdenum	1,0 ПМ)
20	Copper	1,0 (П)
21	Metazyne	3,7 (ПМ)
22	Methanol	12,9 (П)
23	Methylstyrene	1,0 (П)
24	Arsenic	0,1 (П)
25	Oil and oil products	1,0 (ПМ)
26	Nickel	0,5 (П)
27	Tin	20 (П)
28	Polyacrylamide	2,0 (ПМ)
29	Resorcin	0,18 (ПМ)
30	Mercury	0,001 (П)
31	Lead	0,10 (П)
32	Selenium	0,01 (П)
33	Carbon bisulfide	5,0 (П)
34	SSAS (СПАВ)	
	Anion	20 (П)
35	Styrene	0,56 ПМ)
36	Strontium	18,0 (ПМ)
37	Sulphides	1,0 (П)
38	Stibium	0,2 (П)
39	Thiourea	0,13 (ПМ)
40	Titanium	0,1 (П)
41	Toluol	2,8 (ПМ)
42	Tricresyl phosphate	0,03 (ПМ)
43	Phenol	0,05 (ПМ)
44	Formaldehyde	0,6 (ПМ)
45	Chrome trivalent	0,5 (К)
46	Chrome hexavalent	0,1 (К)
47	Cyanides	0,64 (П)
48	Zink	1,0 (П)
49	Active reaction pH	6,5-8,5 (К)
50	Suspended matter	500 (К)
51	Solid residue	2000 (К)
52	Nitrogen	30,0 (К)
53	Ammonia	2,5 (К1)
54	Chlorides	350 (К)
55	Phospates	2,5 (К)
56	Fluorine	1,5 (К)
57	SOD	500 (К)
58	Soap	25 (К)
59	BOD complete	500 (К)
60	BOD_5	425 (К)

(П) – Order of industrial wastewater discharge to sewage system of Tashkent city. 1989
(ПМ) – Order of industrial wastewater discharge to sewage systems of the cities. M. 1985
(К) – Methodology of technical control of operation of city sewage works. M. 1977 г.
(К1) – Ya.Grushko. Detrimental abiotic compounds in industrial wastewater. Leningrad. 1979

Annex 6: Case Study: The River Wey Catchment Quality Review (Great Britain)

This review was undertaken in 1982 by the former Thames Water Authority in Great Britain. The River Wey catchment is a good example of the application of the principles described above because it consists of a number of different tributaries and has twelve significant sewage treatment works discharging to it. The conclusions reached in terms of effluent ELVs were used as the basis for detailed discussions on the appropriate action to be taken.

Geography and background

The River Wey system is a major tributary of the River Thames, which it joins at Shepperton, immediately upstream of two major abstractions at Walton and Hampton, both as raw water for potable supply. The River Wey catchment contains about 187 km of watercourse that is considered sufficiently significant to be worth protecting. The basin drains an area of approximately 1000 km^2, in which the major conurbations are the towns of Farnham and Woking, and the city of Guildford.

The river quality at the time of the review was generally good. 91.3 km of rivers within the catchment were designated as fishery waters, including 15.3 km of salmonid quality.

Twelve significant sewage treatment works discharge into the River Wey and its tributaries, serving a population of almost half a million. Figure 7.1 shows a diagram of the catchment and the relative position of these effluents.

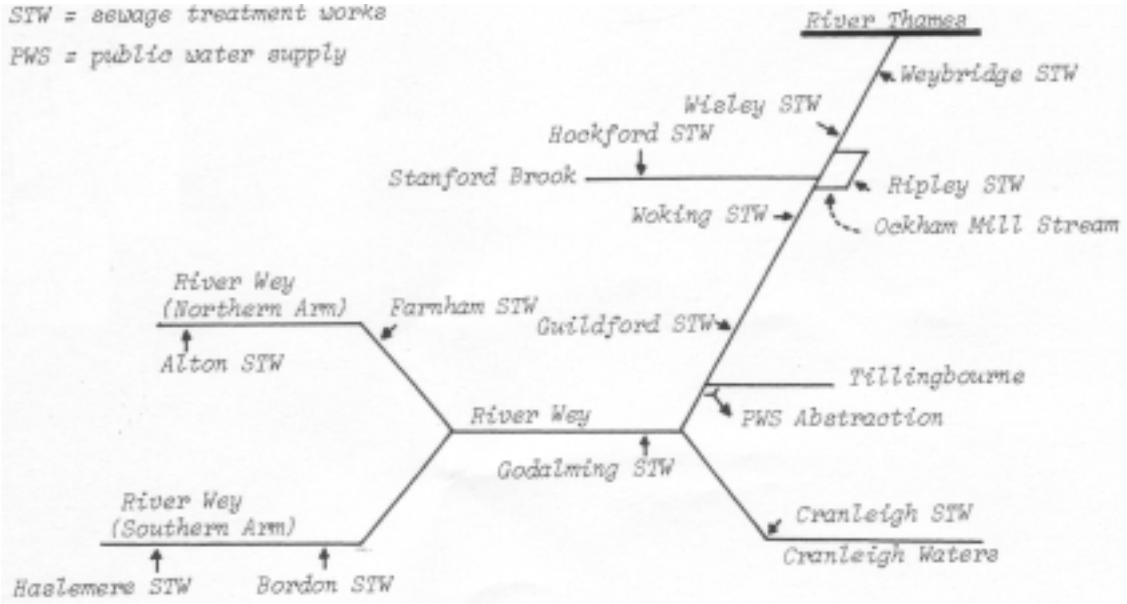


Figure 7.1: River Wey Catchment showing Sewage Effluents

Legally applicable ELVs (known in Great Britain as “consent conditions”) and management target objectives for these works were last reviewed in 1978/79 along with other significant discharges in the Thames area, following national guidelines. However, the procedure adopted at that time made no allowance for those works that might have had spare capacity. Flows to many of these works increased subsequently, as a result of known planned development, making it increasingly difficult to meet the ELVs set for final effluent quality. Conversely, other works, for example those that in 1978/79 were overloaded and in the process of being extended, were given ELVs based on existing performance. These subsequently became inappropriate once the extensions were commissioned. The net result of this process was an increasing number of works (a) failing to meet required

effluent standards or (b) having effluent standards which were met easily without the use of all available capacity.

The overall intention of the River Wey catchment quality review was to look several years ahead and arrive at a hypothetical set of effluent ELVs for each works which could reasonably be achieved over that period, while at the same time ensuring that river quality would be maintained.

Aims of the Study

The aims of this review were:

- To determine ELVs for each of the twelve treatment works that would be achievable for at least 95% of the time over the next five years until 1987, assuming initially no further improvements to the treatment process at any works.

- Initially to assess the impact of this on the river system and to identify where improvements would be most effective, in order to restore and maintain the quality of the River Wey system to that generally prevailing in the period 1975-78, paying particular attention to those reaches that were designated as Fisheries.

- To identify the changes required in order to achieve these objectives.

Assumptions

For the purpose of this review, the following assumptions were made:

- The domestic component of sewage flow will increase in line with growth in population and water usage.

- The industrial component of sewage flow will remain constant, except for an increase expected from a brewery whose effluent is treated at the Alton works.

- The infiltration component of sewage flow will not change over the period considered.

- There will be no significant change in works performance over the five-year period in the absence of any extensions or other process modifications.

- Allowance will be made for the natural purification that occurs within the river system.

Revising ELVs and the Impact on River Quality

The first step was to review the recent performance of each of the twelve works and then to determine the ELVs (95^{th} percentile quality limits) with which each works could be expected to comply over the next five years. It is important to stress that these ELVs were based on the assumption of no further improvements in sewage treatment being made and hence, because of expected increases in flow, would lead to the continuing decline in the quality of rivers.

The next step was to assess the past quality of the River Wey system in order to verify that the river quality objectives being set were realistic. A stochastic steady-state river quality model of the catchment (similar in concept to the model SIMCAT, used by the present UK Environment Agency) was used to evaluate the consequences of no action being taken to improve effluent quality.

Identification of Problem Areas

The review showed that some form of action would be needed if the overall river quality were to be restored and the various objectives met. Examination of observed data pointed to three problem areas in particular:

- The northern arm of the River Wey downstream of Farnham sewage treatment works.
- The main River Wey downstream of Guildford sewage treatment works.
- The Ockham Mill Stream downstream of Ripley sewage treatment works.

Options for Action

Use of the catchment river quality model revealed the following important points:

- It would be possible to restore river quality in the problem areas identified by taking appropriate action and concentrating investment at Farnham, Guildford and Ripley.
- The influence of Farnham's effluent does not extend significantly beyond the confluence of the northern and southern arms of the River Wey, and is lost entirely by the time the river gets to Godalming. ELVs for Farnham could, therefore, be calculated purely on the basis of a local mass balance calculation, without the need to take into account possible interactions with the impacts of other works upon river quality.
- There is a significant interdependence between the effluent quality requirements for Guildford and Ripley. They are sufficiently close together that ELVs could be calculated only by modelling the whole length of river between Guildford and Ripley.
- The main river quality problems arose from significantly increasing levels of ammoniacal nitrogen. Although BOD(ATU)[29] was at the same time following a slight upward trend, there was no immediate danger of it causing failure against river quality objectives.

Target ELVs were therefore proposed for Guildford and Ripley combined (Table 7.1). It is important to note that had these works been considered in isolation, tighter ELVs would have been calculated for Ripley STW. Thus the use of a catchment simulation model can lead to a more optimal allocation of resources. Similarly, ELVs were proposed for Farnham STW (Table 7.2).

Table 7.1: Proposed Effluent ELVs for Guildford and Ripley

River Quality Objective	Guildford STW		Ripley STW	
	BOD(ATU)	Ammoniacal Nitrogen	BOD(ATU)	Ammoniacal Nitrogen
Restoration to the quality obtaining in 1975/78	16.0	4.0	19.0	7.0

Table 7.2: Proposed Effluent Concentration Target Objectives for Farnham

[29] In Great Britain, allylthiourea is added at the time of determining biochemical oxygen demand, in order to suppress the effects of nitrification. The resulting parameter is referred to as "BOD(ATU)".

River Quality Objective	BOD(ATU)	Ammoniacal Nitrogen
Restoration to the quality obtaining during 1975/78	14.0	5.0

Notes:

- **all concentrations are in mg/l, 95%ile**
- **STW = Sewage Treatment Works**

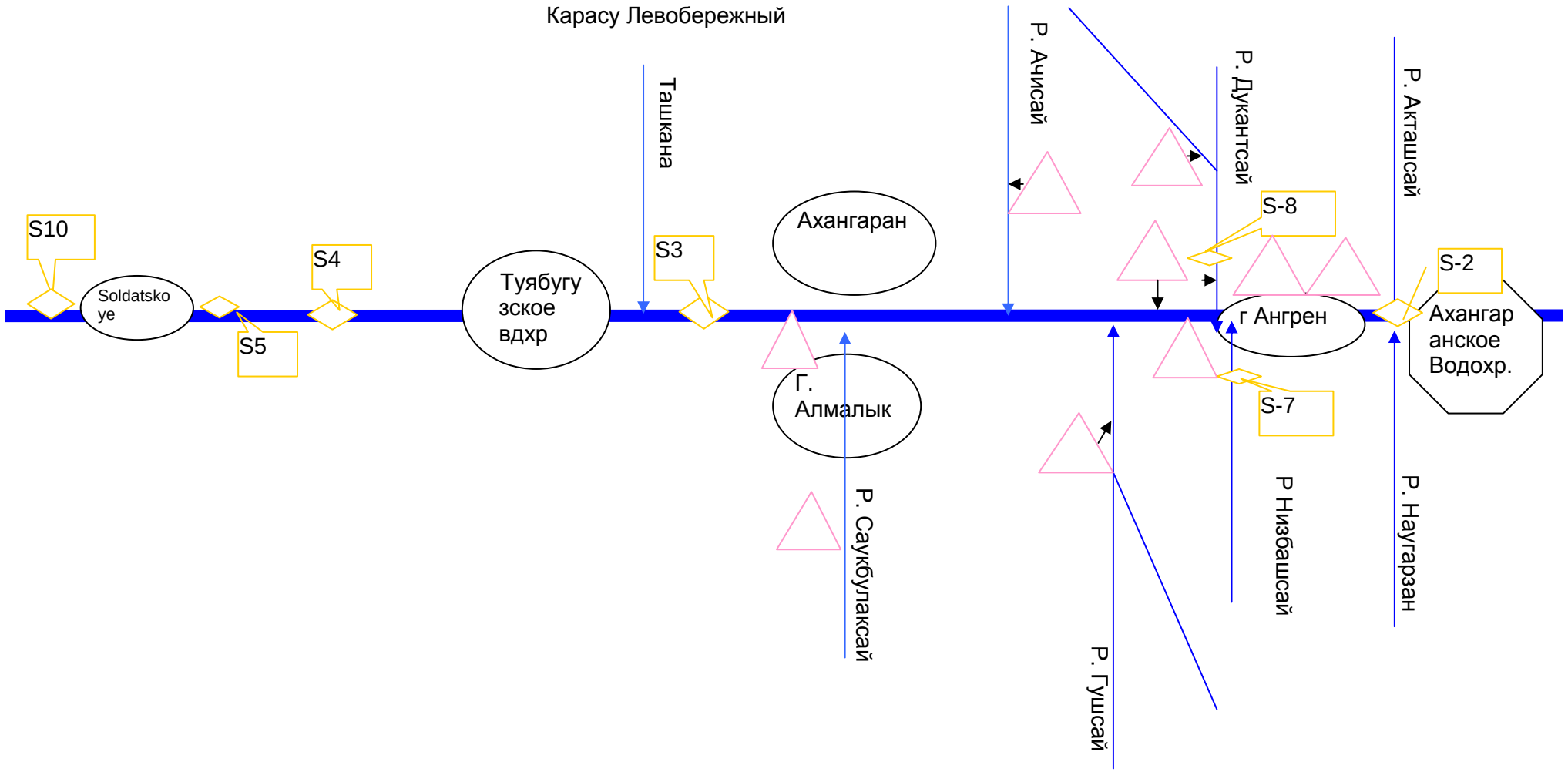
Cost-Benefit Issues

In effect, this review was comparing two approaches to the management of river quality within the Wey catchment. The first of these approaches took a relatively inflexible view, insisting that effluent ELVs in force at the time should be retained and adhered to. The net present value (NPV) of the investments needed to achieve river quality objectives according to this strategy would have been about €14 million at 1982 prices.

The second approach took a much more flexible view of managing river quality, by accepting that the effluent ELVs in force at the time might not be the optimum ones from the cost-benefit point of view. By adopting this strategy, it was found that the NPV of the investments needed to achieve river quality objectives could be reduced to about €8 million.

Annex 7: Scheme of the Akhangaran River Basin

S : Post Hydromet
Z : Wastewater discharge



Annex 8: CD-Rom with the Project's key computer files

The attached CD-ROM includes:

1. The present report in Word Version
2. The present report in PDF Version
3. The files to install the Consents UK Mass Balance programme
4. A small Excel interface to calculate standard deviation and 90th percentile
5. The Excel file including the database used for this report
6. The database of Akhangaran
7. The power point presentations made in seminars
8. EU directives linked to water quality
9. The files to install SIMCAT - UK river basin programme
10. The files to install SEQEau- the French computer programme including French river classifications according to their uses.