PHENOL SPILL IN SITNICA AND IBAR RIVER SYSTEM

UNEP/OCHA Assessment Mission

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United Nations Environment Programme, UNEP/
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Assessment Mission
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REPORT

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REPORT

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1. REQUEST FOR INTERNATIONAL ASSISTANCE

On the evening of 20 January 2003, the Ministry for the Protection of National Resources and Environment of the Republic of Serbia contacted the Joint UNEP/OCHA Unit requesting assistance with respect to recorded high levels of phenol by the authorities in the Ibar river, a trans-regional waterway between Serbia and Kosovo with its major upstream tributary - the Sitnica river. Serbian sources said that in the city of Kraljevo, the contamination caused interruptions to the potable water supply. As per standard practice, the Joint UNEP/OCHA Environment Unit sent the "Notification/Request for International Assistance" form to the Ministry for the Protection of Natural Resources and Environment of the Republic of Serbia. The Joint UNEP/OCHA Environment Unit received a completed form on the morning of 21 January 2003. This form gives an indication of the nature, scope and extent of the threat and also serves as the official request to authorize the Joint UNEP/OCHA Environment Unit, as a UN body to mobilize the requested assistance.

Donors and Governments which had provided similar assistance in the past were approached by the Joint UNEP/OCHA Environment Unit to consider the possibilities of making resources available to conduct the assessment.

Given that the source of the contamination could have originated upstream in the Sitnica River, contact was also made by the Joint UNEP/OCHA Environment Unit with the United Nations Interim Administration Mission in Kosovo (UNMIK) to investigate the possibility of extending the assessment into Kosovo. The UNMIK provided their verbal confirmation and followed up through a written request, which was received by the Office of the Executive Director on 27 January 2003. The request was also forwarded directly to the Joint Unit by UNMIK on the same day in order to facilitate planning of the mission.

2. MISSION

The mission was a joint venture of UNEP and OCHA, organized by the Joint UNEP/OCHA Environment Unit. The terms of reference of the mission included an assessment of the situation that could have led to the high phenol levels recorded in the Ibar river, the collection of data related to the recorded high levels of phenol, and the environmental implications of such levels and the preparation of recommendations for future action and prevention. As part of the work, sampling, analysis and discussions took place with national and local experts, national authorities, experts from UNMIK and local non-governmental organizations (NGOs), the last in Serbia. The mission lasted from 17 to 26 February 2003 and was conducted in two-parts travelling from Pristina in Kosovo then to Belgrade and Kraljevo, the last the major area of concern within Serbia. The team was composed of four experts. An expert from Switzerland and Germany respectively, one from UNEP's Post Conflict Assessment Unit, the other from UNEP's Disaster Management Branch who also headed the team.

The mission was limited in size, scope and time and consequently was not intended to provide a full overview of the emergency and its implications. It mainly represented a first step towards finding a long-term holistic solution to sustainable management of the Sitnica-Ibar watershed.

The range of expertise in the team included chemistry, ecotoxicology, water and sanitation engineering and environmental economics. In order to take advantage of UNEP existing internal capacity, three entities were involved in the mission: the Joint UNEP/OCHA Environmental Unit in its capacity as the focal point for response to environmental emergencies; the Disaster Management Branch in its capacity as the overall co-ordinator of the programme on environmental emergencies; and the Post-Conflict Assessment Unit in its capacity as having had previous experience in the region following the Balkans conflict of 1999.

3. THE FOCUS AREAS

3.1 The Sitnica - Ibar Watershed

The source of the river Ibar is in the eastern part of Montenegro, on the slopes of mountains Hajla and Mokia, from where it flows along the Kosovo valley until the mouth of the river Sitnica, in west-east direction. After joining with the Sitnica it turns north and flows all the way until it contributes into West Morava, near the town of Kraljevo.

The total length of the river is 280 km. The Ibar river basin covers an area of 8,059 km^2. It drains the area of the mountain ranges of Kosovo valley and the valley itself, the area of Starovlaške mountains together with the Pešter plateau and Kopaonik together with mountains Željin and Goč. After joining with the Sitnica, the Ibar starts flowing through a relatively narrower and deep valley between Kopaoink, Željin and Stolovo on the right side and Rogozna, Golija, Radočel and Čenervo on the left.

Legislation concerning water pollution control and waste water treatment in the Republic of Serbia is based on the legislation of former Republic of Yugoslavia which is based on the quality of receiving water after mixing with effluents. Accordingly, rivers (watercourses) are classified in four classes according to their pollution level and their use.

The classes are:

- Class I: water that, in natural state or after disinfection, can be used for the supply of drinking water, food industry and fine fish (salmonidae) breeding.
- Class II: water appropriate for bathing, recreation, water sports, less fine fish (cyprinidae) breeding, including water that, after basic treatment methods (coagulation, filtration and disinfection), can be used for the supply of drinking water and the food industry.
- Class III: water that can be used for irrigation and industries except for the food industry.
- Class IV: water that can be used only after special treatment.

Water courses falling into class II that are not crossing borders with neighbouring countries, are subdivided into two subclasses:

- Subclass IIa: water that, after basic treatment methods (coagulation, filtration and disinfection), can be used for the supply of drinking water, bathing and the food industry.
- Subclass IIb: water that can be used for water sports, recreation, less fine fish (ciprinides) breeding, and cattle drinking.

It must be highlighted that this kind of approach has been abandoned in Western Europe and North America and improved by appropriate requirements of effluent quality and/or minimal removal efficiency for certain parameters.

According to the Report on the State of the Environment in 2000 and Priorities in 2001 for Serbia, the waters of Ibar and its tributaries were analyzed at three points: Raška, Ušće and Kraljevo. Near Raška, the water was loaded with organic matter that caused the oxygen deficiency and high biochemical oxygen demand; the water corresponded to the 2^{nd} - 3^{rd} class category.

Near Ušće and Kraljevo, this quality of water was improved by natural purification processes and by the influence of the tributaries; the water corresponded to the 2^{nd} class category. In one case near Kraljevo a slightly increased concentration of phenol and suspended material was noted, which represented an isolated case.

In autumn, the oxygen deficiency was also detected in the waters of the Raška, but generally this river corresponds to the 2^{nd} class category.

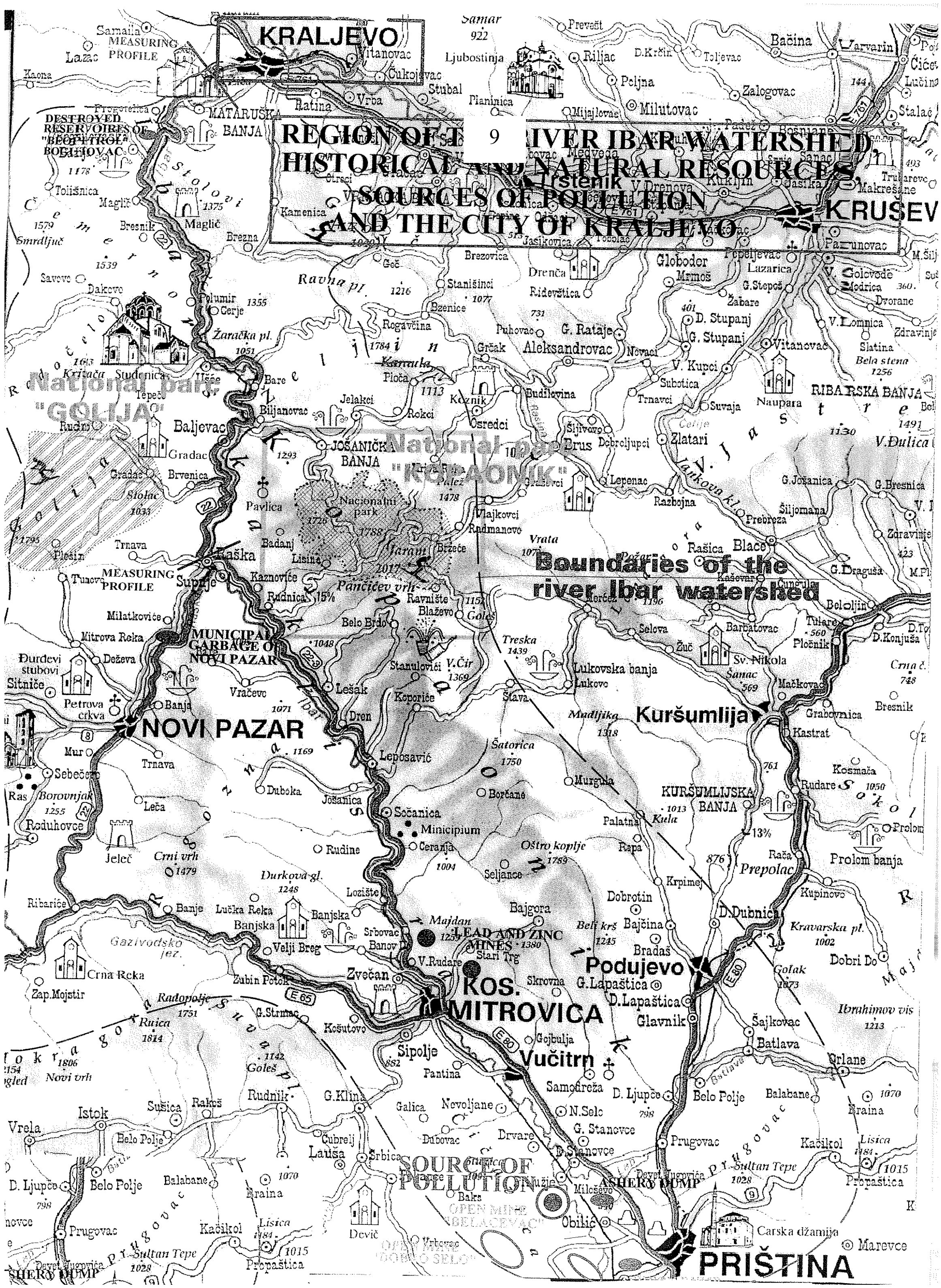


Figure: Sitnica - Ibar watershed

3.2 The industrial complex in Obiliq/Obilic - Power Plants

A major source of pollution in Kosovo in the region of Pristina is the industrial complex in Obilic. This industrial complex consists of facilities that produce hazardous emissions in the area of Pristina and beyond. The main sources of emissions from the industrial complex are: open pit mining for lignite used as a fuel in the power plant - Korporata Energjetike Kosovës (KEK); power generation in power plants "Kosovo A" and "Kosovo B"; lignite drying and heating plants (producing steam for the power plants). In the past, the gasification and fertilizer plants were also sources of pollution but these were permanently closed down in 1988/89. The drying plant has rarely worked over the last three years.

The exploitation of lignite for generating energy in the region has taken place for a long time and the lignite deposits are considered to be the second largest in Europe. The process is based on the "Lurgi" technology of the 50s which today is rarely applied due to huge pressure on the environment. It essentially involves a series of specialized operations for energy production based on open pit mining of lignite as a fuel source.

The power plants in Obilic are considered a major source of pollution due to emissions of sulphur dioxide, nitrogen oxides, dust, fly ash, smoke, radioactive sulphates and carbon gases. Apart for these emissions to the atmosphere, effluent water is also discharged to the Sitnica river containing a cocktail of substances including phenol which is a by-product of the industrial process.

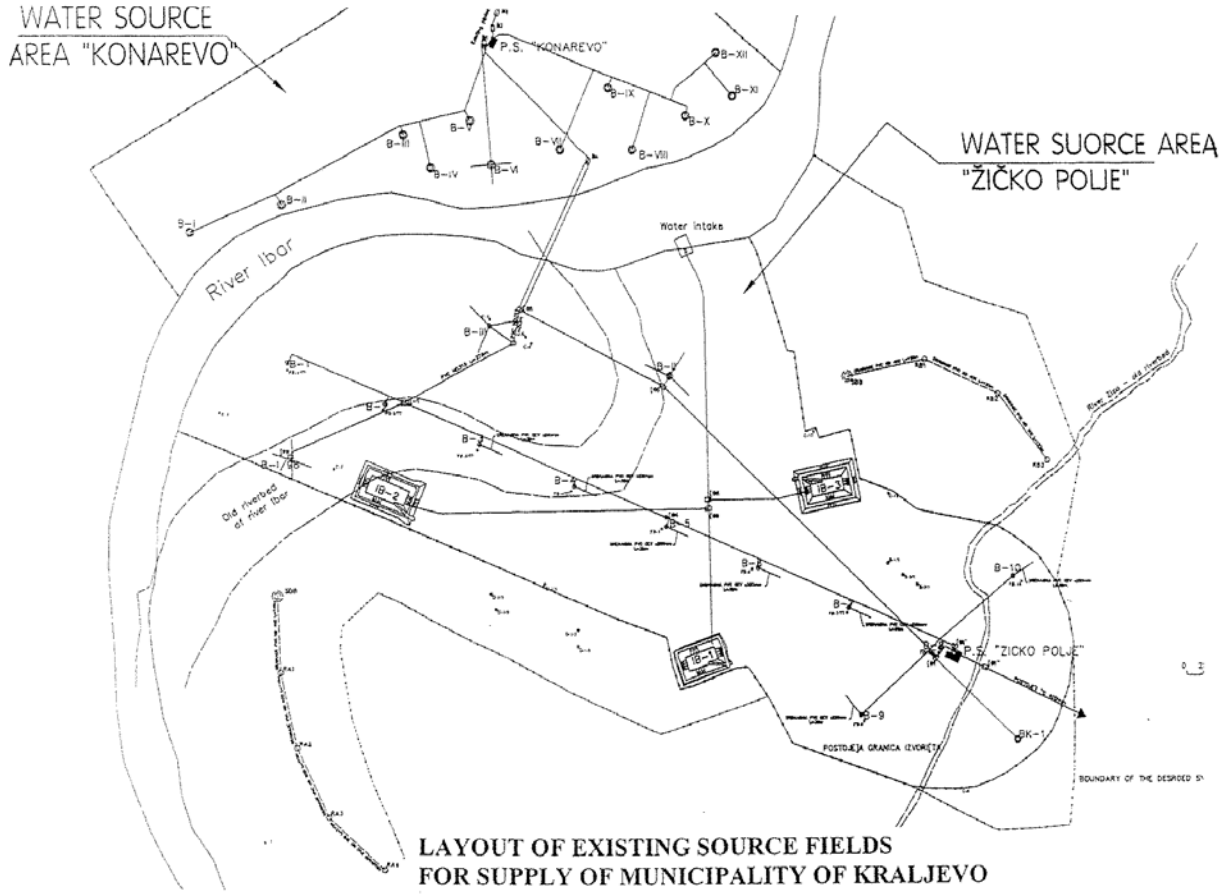
3.3 City of Kraljevo

The city of Kraljevo located some 200 km north and downstream from Pristina is an important administrative and industrial centre in Central Serbia - Centre of Raska country. According to the census of 2002, the town of Kraljevo has 57,761 citizens, the whole municipality has a population of 122,035, while Raska country comprising of 5 municipalities has a registered population of 290,816.

It is estimated that the number of refugees from Kosovo and Metohija living in the municipality of Kraljevo is approximately 25,000 - 30,000. Since the middle of the last century the city of Kraljevo has relied on the Ibar river for its potable water supply. The first well was connected

by the Germans (Djeriz) in 1937 on the left bank of the river Ibar close to the city centre and a second (Streliste) 2 km downstream also on the left bank was connected in 1942.

The city of Kraljevo uses groundwater from the alluvial sediments. Groundwater recharge is mostly due to river bank filtration of Ibar river water, although there is also recharge due to underground inflow from the upgradient zones of the alluvium. Natural groundwater flow is in the same general direction as the river Ibar flow. Groundwater resources in the zone of the city present an optimal resource for water supply. On the other hand, its reliability is due to direct hydraulic contact of river water and groundwater, highly dependant on surface-water quality.



LAYOUT OF EXISTING SOURCE FIELDS FOR SUPPLY OF MUNICIPALITY OF KRALJEVO

The layout of existing source fields for potable water supply of the municipality of Kraljevo shows that Kraljevo is supplied by a network of water supply wells feeding into two main pumping stations: Konarevo on the left bank and Žičko polje on the right bank of the Ibar river. There is a network of approximately 24,000 connections making-up the water supply system of the city.

According to Kraljevo Waterworks, groundwater extraction rate from the existing groundwater sources is approximately 300 l/s. According to estimates of Institute Jaroslav Cerni, total capacity of groundwater resources in low-flow conditions (summer period) is approx. 250l/s. Current maximal water demand in Kraljevo is 380l/s. Loses are estimated at 25%.

4. FACTS ON PHENOL

The assessment mission's primary focus was on phenol in view of the detection of an increase of phenol concentration in the Sitnica and Ibar river system. However, in view of the concern of the potential sources of pollution into the river system, the assessment also considered the issue of phenol within the larger perspective of pollution sources discharging to the river.

Main characteristics of phenol of interest to the assessment.

Phenol is a colourless, or white solid when it is pure. It is usually sold and used however as a liquid. It has a strong odour that is sickeningly sweet and irritating. It evaporates more slowly than chlorine and dissolves fairly well in water.

Solubility in water:	82 g/l at 15 ^{0}C	
Saturation conc. in the area:	0.77 g/m^3 at 20 ^{0}C; 2.0 g/m^3 at 30 ^{0}C	
Odour:	characteristic medicinal, sickening sweet and acrid with sharp and burning taste	
Human odour perception:	about 0.18 g/m^3	
Manmade sources, excreted by man:	in urine	0.2 - 6.6 mg/kg body wt/day
	in faeces	0 - 3 mg/kg body wt/day
	in sweat	2 - 8 mg/100ml
Wastewater treatment:	oxidation by activated sludges acclimated to the following aromatics: 250 mg/l influent, 30 minutes aeration:	
	Phenol:	39% theor. oxidation
	o-cresol	34% theor. oxidation
	m-cresol	37% theor. oxidation
	p-cresol	20% theor. oxidation
Aquatic reaction:	photooxidation by UV light in aqueous medium at 50 ^{0}C: 10.9% degradation to CO_2 after 24 hours.	
	Autooxidation at 25 $t_{½}$ 286 h at pH 9	
	$t_{½}$ 629 h at pH 7	
Biological effects:	human oral ingestion: 1g dose may be lethal	

Table - Human Health Effects from Eating or Drinking Phenol		
Levels in Water (ppm or µg/l)	**Length of Exposure**	**Effects**
5000	Once	Death
100		*Minimal Risk Level (derived from animal data)*
Levels in Food	**Length of Exposure**	**Effects**
	Short tem (<=14 days)	Not known
	Long term (>14 days)	Not known

Table - Animal Health Effects from Eating or Drinking Phenol		
Levels in Water (ppm or µg/l)	**Length of Exposure**	**Effects**
20,000	Once	Muscle tremors, loss of co-ordination, death in rats
24,000	9 days	Decreased fetal body weight in rats
28,000	9 days	Birth defects in mice
Levels in Food	**Length of Exposure**	**Effects**
	Short tem (<=14 days)	Not known
	Long term (>14 days)	Not known

Note: Effects at the lowest level at which they were first observed.

In summary, phenol can be toxic by ingestion of a high dose of the pure product. The product is slowly biodegraded by autooxidation or by photooxidation in the environment. Phenol is also a by-product in the biosynthesis of carbohydrates and is excreted which means that the compound can be found in domestic wastewater and subsequently in surface waters of rivers receiving untreated wasterwater effluents.

Chloro derivatives of phenol (chlorophenols) are more toxic than phenol itself. The chlorination of water containing small quantities (microgrammes) of phenol to form chrolophenols although a theoretical possibility is highly unlikely in circumstances of low temperatures encountered, for example, at water pumping stations since the rate of reaction would be extremely slow.

5. PREVIOUS SPILLS OF PHENOL

As early as 1966/67 there were indications that the water quality in the Ibar river was deteriorating. This coincided with the time that the gasification facilities were put into operation in Obilic. In the late seventies, phenol was found to be present in the Ibar river.

Accidental pollution by phenols in Ibar river and its upstream tributary, the Sitnica river, was first registered in 1983. For example, phenol concentrations in December 1983 were: 364 µg/l in the Ibar at Kraljevo; 540 µg/l upstream at Leposavic and up to 4000 µg/l upstream in the Sitnica river. During the years 1984 and 1985, concentrations of phenol were for the most part above the maximum permitted value of 1µg/l. The concentrations detected ranged between several µg/l to several hundreds µg/l with the resulting concentrations in groundwater used for water supply of Kraljevo in the order of tens of µg/l. The analysis of phenolic compounds showed a predominance of ortho- and paracresol and types of xylenol. The presence of phenol did not exceed 20%.

Use of groundwater for the potable water supply of Kraljevo has been interrupted a number of times: first in the period 24-27 May 1984. During 1985, phenols in Ibar river were detected for 170 days. Groundwater was not used for water supply during the period 2 July - 4 September 1985 and 27 November - 15 January 1986. During the rest of 1986 and for all of 1987, the concentration in the groundwater was below the maximum permitted values for drinking water. The decrease in industrial activities during the 90s led to an improvement of river water quality and as a result allowed regular use of groundwater for water supply of Kraljevo.

6. ASSESSMENT

The assessment of the phenol pollution is taken from two main sources; background reports provided by the authorities in both Kosov and Serbia and information collected by the UN mission.

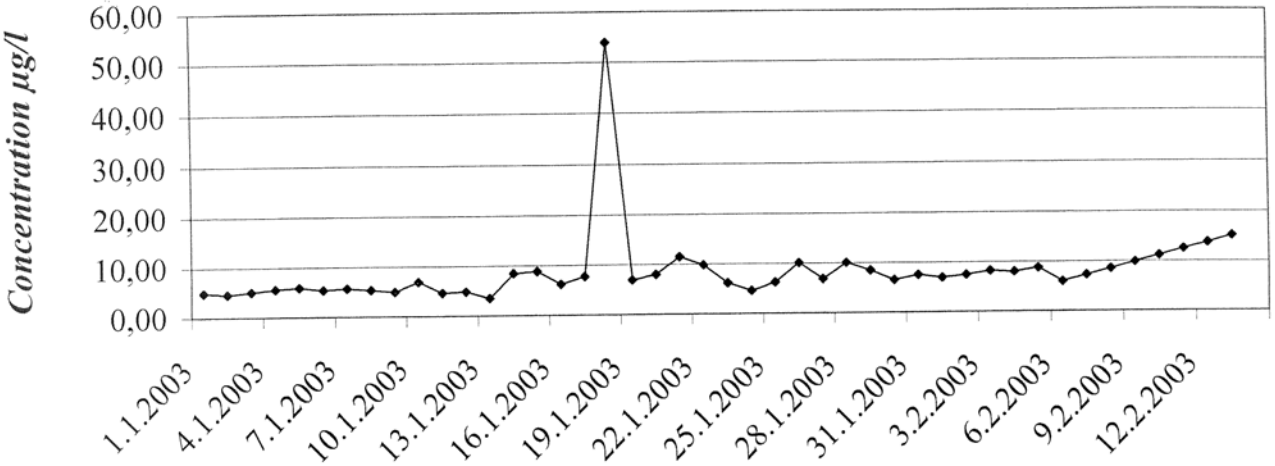
6.1 High levels of Phenol in the Ibar-Sitnica River System in January 2003

6.1.1 Initiatives taken by the Serbian authorities

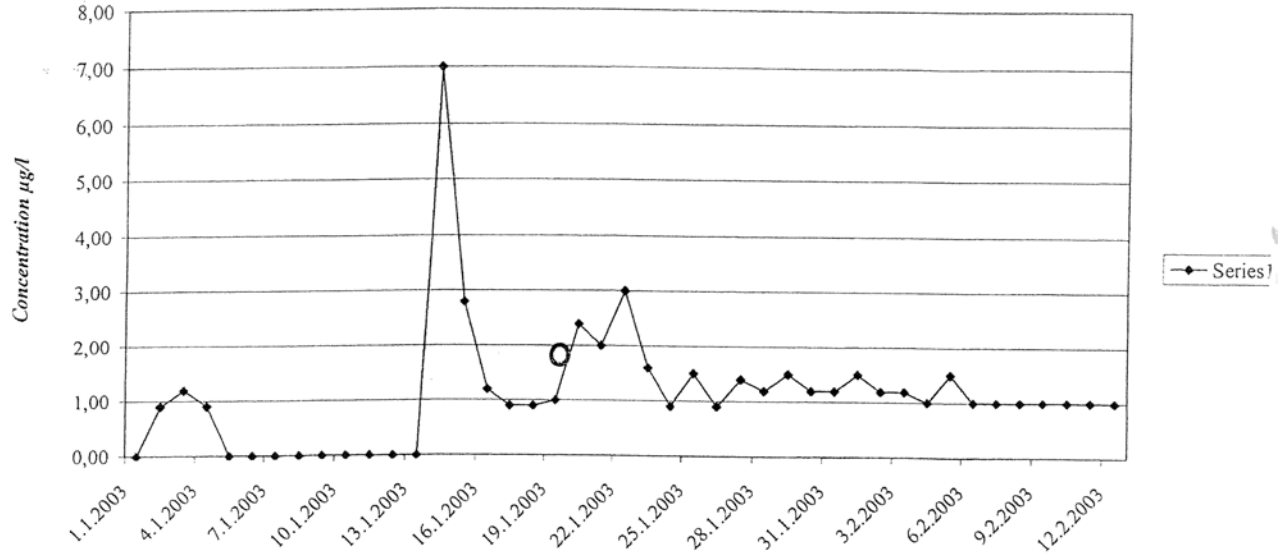
On January 14, as part of the regular monitoring programme of the water quality of the river Ibar, carried out by the Hydrometerological Institute of the Republic Serbia showed that concentrations higher than the norms were detected near Kraljevo (0.7 µg/l) and Raška (7.2 µg/l). This prompted the authorities to conduct more frequent sampling and analysis along the Ibar river system. Results did show pulses of phenol concentrations in the river Ibar water above the maximum permissible concentration for class II waters. From 14 to 17 January, the results of the analysis indicated that the concentrations of phenols were returning to the expected values for the Ibar river. However, on January 18, a pulse of phenol was detected in Raška with the highest concentration (54.80 µg/l) registered at 5 p.m. The increased frequency of monitoring continued until 17 February after which monitoring of water quality continued as per normal as concentrations of phenol decreased and returned to the expected values.

On January 20, the Government of the Republic of Serbia appointed the Minister of the Protection of Natural Resources and Environment to co-ordinate activities for establishing the reason for the observed high concentrations of phenol.

Registred concentrations of phenol in the river Ibar water
at measuring profile Raska
during the period of 1 January through 14 February2003



Registred concentration of phenol in the river Ibar water
at measuring profile Kraljevo and Mataruska Banya - O
during the period from 1 January through 16 February 2003



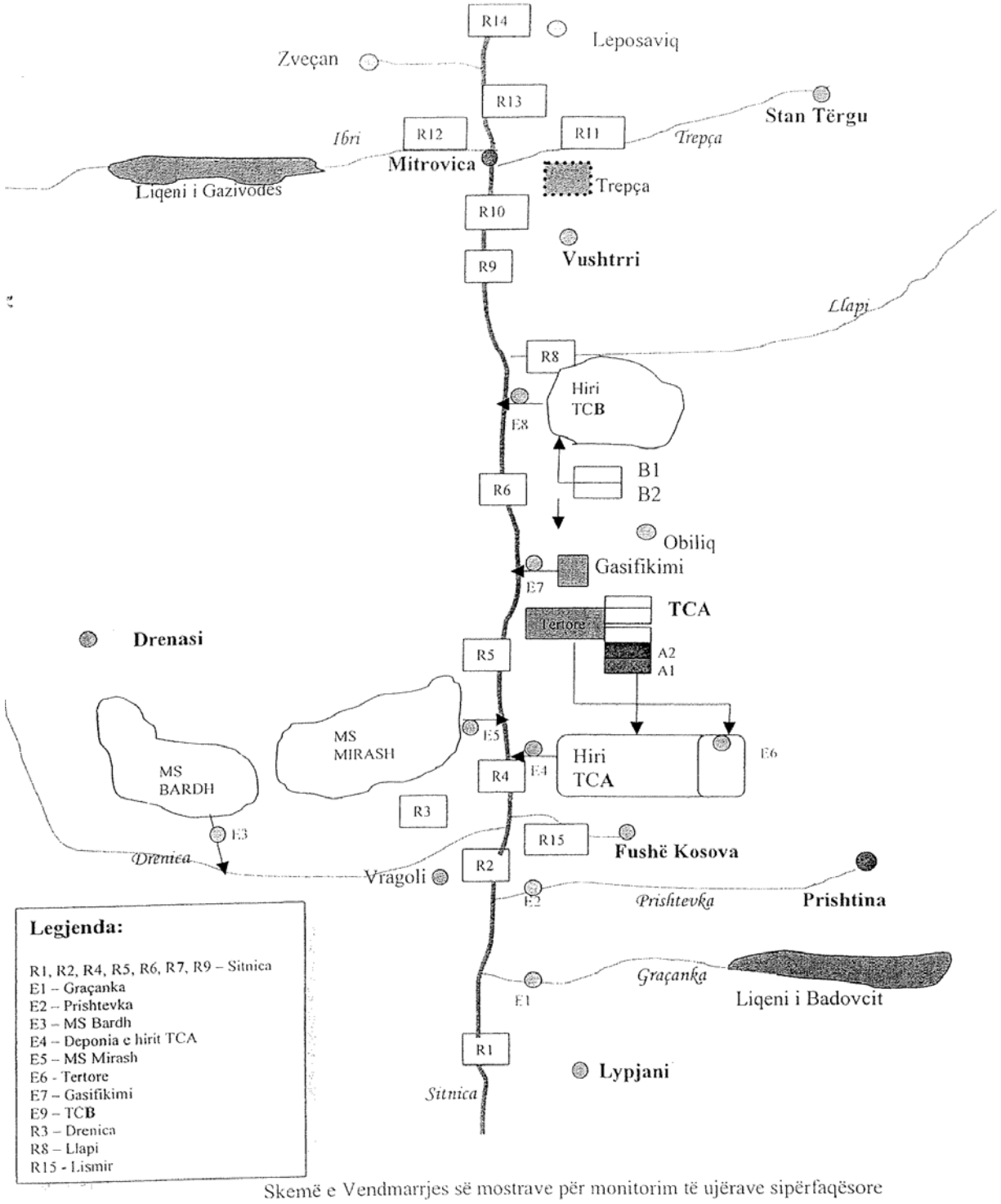
One initiative was the establishment of a team of experts with the task of surveying the industrial facilities of Obilic with a focus on KEK in particular the gasification facilities since these were felt to represent the source of phenol pollution in the Sitnica river and due to the large quantities stored was considered a potential danger for even greater pollution than the one observed. River water samples at key points along the river were also taken. This was done in coordination with the UNMIK administration. The mission was conducted on 23 January 2003.

On January 27, the Minister for the Protection of Natural Resources and Environment held a meeting with representatives of the local government of Kraljevo and with the chief of Raška county to start a process of finding a long-term solution to the problem of potable water supply to the city of Kraljevo.

6.1.2 Initiatives taken by UNMIK and MESP

On January 17, high concentrations of phenol were reported to the Ministry of Environment and Spatial Planning (MESP) of the Provisional Institutions of the Self Government in Kosovo in the river Ibar below Mitrovica. This initiated an intense sampling campaign by the Hydrometerological Institute of Kosovo in the river Sitnica from Vragoli to Mitrovica. For the next few days, high concentrations were found in the vicinity of KEK power stations but concentrations later decreased until high concentrations were again detected on 24 January at the same locations.

On 25 January, a monitoring plan lasting two weeks was agreed upon between KEK management, MESP and the DoE of UNMIK and carried out by the Hydrometerological Institute of Kosovo (KHMI). The monitoring plan included all inflows into Sitnica river near Ferizaj, Drenica, Gragorka, Pristina, Fushë Kosova, IIap, Iber at the exit of Mitrovica including numerous point source within the KEK complex.



Skemë e Vendmarrjes së mostrave për monitorim të ujërave sipërfaqësore

Figure: Sampling points of the campaign carried out by KHMI

A working group of experts was also formed by MESP to find a permanent solution to rid the site from the large quantities of concentrated phenol and phenol waste waters stored at the gasification facilities of KEK. In addition, on 20 January, the National Institute of Public Health (NIPH) also conducted a sampling campaign to determine the extent of phenol contamination in the drinking water supply in nearby wells along the Sitnica river (**See section 6.1.7**).

6.2 Overall assessment of the environmental situation in the Sitnica - Ibar river system

The brief qualitative survey along the Sitnica - Ibar river system conducted by the UN mission as well as discussions with the local experts indicate a long time of neglect leading to imperilment of the general well being of the environment due to agricultural run-off, direct discharge of domestic wastewater and solid waste due to lack of wastewater treatments, thereby contributing to eutrophication of the river. As a note, access to the sewage system in urban areas in Kosovo is 28% while in rural areas is only 7%.

In addition, the UN mission was informed of ongoing sources of pollution into the river system such as the seed-oil factory in Feruzaj, the paper factory and the bottling plant in Lipjan. The industrial effluents are also not treated before discharge into the rivers. Considering the old industrial technologies in use in some of these industrial complexes located within the catchment area of the Sitnica - Ibar river system which are not of low volume waste design, there is no doubt that a cocktail of industrial pollutants will reach the river system an be present in surface waters.

Undoubtedly, the ecological state of the river system has been influenced by a long history of:

- excessive inputs and organic matter, leading to eutrophication;
- hydrological and physical changes leading to impacts on the water level;
- siltation from inadequate erosion from agricultural activities;
- contamination from industrial sources.

The ecosystem has therefore changed and in some cases deteriorated well before this incident. Indeed, the changes of a natural ecosystem due to these influences is a problem of other water courses in the region as well as of other Eastern European rivers.

6.3 KEK

Figure: Chimneys from power plant

Built in the early 70s, KEK is a large industrial complex whose function is to produce gas, electricity and dry coal. KEK faces the dilemma of having to strike a balance of producing energy with limited pollution effects at the same time using outdated technology. In addition, its financial return does not allow any form of capital investment to improve its waste management practices. The raw material to fire the turbines of the power stations is lignite extracted through open pit mining. Nowadays, only the lignite mines and the power plants are in operation. Due to the extensiveness of the complex, the UN mission was only able to get a general overview of the environmental state of KEK and its immediate surrounding. A list of potential pollution sources from the complex albeit not exhaustive are:

- Lignite mines
  - Waste water pumped to the river
  - Combustion gases

- Drying plant (not in operation)
  - Condensate water

- ♦ Gasification facilities (not in operation)
  - Phenol water
  - Ammonium water
- ♦ Power plants
  - Fly ash
  - Bottom ash
  - Fuel gases

- ♦ Ash landfills
  - Contaminated water after percolation
  - Dust particles

- ♦ Contaminated soil
  - Contaminated leachalt

Although the mission could not determine how much of the lignite burned remains in the form of ash, reports from other sources show that 95% of all ash produced by coal combustion utilities is composed of oxides of silicon, aluminium, iron and calcium. Ash also contains may other trace elements that vary by type and level depending on ash particle size, source of the coal and other factors: these elements some of them radioactive, include arsenic, barium, cadmium, copper, lead and mercury. Many are in the form of oxides tied up in complex silicates. There is pressure on large expenses of agriculture land because of the open pit mining and the use the land surface for the ash landfills which reach 250 - 300 metres high in some cases.

Figure: Ash land fills

Due to this heritage of the past years, KEK has contributed to levels of chronic (persistently recurring) soil, water and air contamination that comes from the decades of lignite exploitation and unmanaged combustion utility wastes generation.

In addition, relatively large quantities of concentrated phenol and phenolic water are stored in large tanks in the area of gasification facilities. The storage tanks seem to be intact and in fairly good condition and no severe corrosion damage could be observed although a faint smell of phenol could be detected close to the tanks and around the man holds close to the biological treatment. Visual inspection of the valves of the tanks showed that they too are also in relatively good condition although the electrical installation is in poor shape. Having mentioned all this, should a decision be taken to sell the phenol to an outside buyer a proper survey of the tank pipe system and pumps would need to be carried out if the tanks are to be emptied in a safeway.

Figure: Storage facilities for phenolic waters at KEK

In conclusion, a number of potential sources of phenols could be identified within KEK related to: the pumping of water from the mine, washing of lignite, leaching of water from ash landfills and release of polluted water associated with the gasification facilities. There is therefore a need of a detailed environmental audit of the KEK to obtain a clear picture of the pollution sources and their extent of contribution to the overall phenol pollution of the Sitnica river.

6.4 Evaluation of Local Analytical Capacity

In order to evaluate the information provided to the mission, the UN mission visited the local laboratories and discussed approaches and methods with technicians and scientists to ensure that data could be compared and that quality control would be appropriate in each of the laboratories. The visits also proved useful in obtaining data and information on contamination of the river by other substances than phenol.

In Kosovo, different institutions were involved at some stage in the analysis of phenol: INKOS (a monitoring and research entity of KEK) which monitors water quality within the complex among other responsibilites; KHMI (Hydrometerological Institute of Kosova) which has the legal obligation to perform control and monitoring of the surface and ground waters, rivers, air and soil; NIPH (National Institute for Public Health) which is responsible for monitoring drinking water quality.

In Serbia, different institutions were also involved in the monitoring of phenol: the local laboratory in Kraljevo; RMI (Republic of Serbia's Hydrometerological Institute); the Institute for Health Protection in Kraljevo. Competencies of these institutions are similar to those in Kosovo. However, the UN mission was informed that when the incident of high phenol levels took place in January, the analysis for drinking water was done by the Institute for Health Protection in a nearby town.

Figure: RSHMI laboratory in Kraljevo

Phenol is determined according to standard procedures. With the exception of the Institute for Health Protection in Kraljevo, which uses a gas chromatographic method, colourimetric method is used which is based on colourmetry which measures total phenol. The UN team found that with the uncertainties because of sampling, different and quality instrumentation and human resource capability, the results that are generated could be used to establish a first warning where changes in concentrations of phenol in the river waters occur.

The UN team however noted that intercalibration studies of the analytical laboratories applying their methods need to be carried out as well as some capacity building of the personnel working in the INKOS and the local laboratory in Kraljevo of RSHMI.

6.5 The UN Sampling

The UN mission sampled at a few points along the Sitnica-Ibar river system. Since the purpose of this exercise was not to obtain a representative overview of water quality or an attempt to identify baseline contamination in the area but to see if comparable data according to interntional standards can be generated by the different entities carrying out sampling and analysis, in agreeement with the parties involved, the UN mission carried out sampling at selected points. Simultaneously that this sampling was carried out, the samples were also taken by personnel from the different laboratories responsible for carrying out analysis of the river water. Samples collected by the UN mission were analyzed by an independent laboratory in Switzerland.

Figure: Sampling point within KEK complex ***Table with results (needed - Nicole)***

6.6 Drinking Water

In Kosovo, the town of Pristina and the villages in the area have private wells that are shallow and are thus highly vulnerable to surface pollution and pollution from Sitnica river which is the catchment area for a number of these wells.

A comparison of phenol concentrations results for January 20 with those of 17 February carried out by NIPH shows that:

- In January 20, all the wells contained phenol concentrations higher that the maximum admissible drinking values;
- By February 17, all phenol concentrations had decreased appreciably and there was no risk or threat to human health.

The UN mission did note that chronic health risks of the local population could exist from bacteriological contamination of the well water due to the shallowness of the wells which make them vulnerable to surface run-off from domestic waste.

In Kraljevo, as stated earlier, the town is supplied by a network of water supply wells feeding into main pumping stations: Konarevo and Žičko polje on the left and right banks respectively of the Ibar river. A visit of the UN team to a pumping station showed that it was in good working condition (e.g. pumps, chlorination system) with skilled technical personnel operation the pumping station.

Figure: Pumping station visited by the UN mission

The network of wells supplying potable water are for the most part located far enough from the Ibar river bed. Thus for these wells, the process of filtration and siltation by alluvial sediments will reduce the concentrations of pollutants on their way to the wells. However, some wells are located within too short a distance from the riverbed (mainly in the Konarevo field). According to the results of hydrodynamic modeling of the groundwater resources of Kraljevo, these wells have a retardation time of only 5 - 6 days and are the ones most susceptible to rapid breakthrough of pollutants from the Ibar river.

Results obtained from the different entities involved in water quality monitoring show that over the past years the phenol concentrations in potable water for Kraljevo are not harmful to human health. Undoubtedly, the water quality of the Ibar river can be improved in as much that the industry and the local communities around the catchment area of the Ibar river discharge their waste water without adequate treatment. Although the river has a certain potential to auto-depurate organic pollution, there is no doubt that the total pollution load entering the river can at some stage exceed its assimilate capacity.

The UN team concluded from the examination of the results of the phenol concentrations for the Ibar river during the period of concern (January) that the major peak of phenol concentration observed at the sampling point in Kraljevo on 14 January cannot be linked to any phenol released up-stream in the R□ska area. On the other hand, the peaks observed in Kraljevo between 20 to 21 January can be linked to phenol in the R□ska area on 18 January (**see graphs in Section 6.1.1**). This is reinforced by the lowerer but wider spread of the concentration of phenol seen over time at Kraljevo. These results signify the following:

i. The first pulse of phenol detected around the 14 January in Kraljevo could have originated form a source between R□ska and Kraljevo;
ii. The hydrological, chemical and biological components of the river for dealing with a pulse of phenol have behaved according to the expectation;

6.7 Liability and Compensation

The UN mission did not address the question of liability and compensation related to the spill and its consequences although the issue was raised during the meeting with local authorities and NGOs in Kraljevo.

6.8 Summary

The findings of the assessment are:

- The Sitnica - Ibar catchment are significantly polluted by domestic and industrial waste water due to a lack of municipal and industrial wastewater treatment facilities as well as due to an inadequate waste management strategy.
- Indications are that KEK contributes significantly to the pollution of the Sitnica river although the extent has yet to be determined.
- Other sources of phenol to the Sitnica river exist.
- The highest concentration of phenol in the Ibar river recorded in January is not necessary attributed to releases of phenol upstream in the Sitnica river.
- In January, drinking water supply of Kraljevo was never endangered by the concentrations of phenol present in the Ibar river.

7. Recommendations

The UN mission was limited in time and scope. Its findings and recommendations are of a preliminary nature, but should give direction towards finding a long-term holistic solution to sustainable management of the Sitnica - Ibar watershed. The following recommendations should therefore be seen in this vein. Furthermore, the long history of the use of outdated industrial technologies, the socio-economic and political situation prevailing in the area would require that these recommendations are implemented in phases.

7.1 Information (short and long-term)

There is a need for more information exchange especially among the Serbian authorities, the population of Kraljevo and NGOs. People in the city of Kraljevo are well aware that pollution by phenol has occurred in the past and there is a general mistrust on their side of the information being disseminated by the authorities when pollution incidents occur and of the overall water quality of the Ibar river. Involving civil society will improve the quality of decision-making as well as tend to strength public belief in the credibility of the decision-making process and its outcome.

7.2 Alarm network

In the short-term, based on the existing monitoring alarm network can easily put in place at the river basin level (Sitnica and Ibar) which can serve as an early warning mechanism downstream as soon as sudden cases of hazardous substances in the Sitnica - Ibar river are detected. Included in this network should be the organizational responsibilities on-site (in this case KEK) as well an off-site for dealing with future accidental spills. Minimum requirements would necessitate:

- development of an alert and fan-out procedure including the preparation of a standard format for the notification of results between the different entities;
- development of clear and fast communication procedures between the different entities including an up-to-date contact roster, which may include individuals within the entities since it is unlikely that these entities operate on a 24 hour basis;

- definition of a clear decision-making chain in order to take the appropriate response measures.

Such an alarm system will not reduce the pollution but give enough time to the authorities to decide on whether to shut down the water supply. At a later stage, standardization of sampling and analytical procedures should be encouraged as there is a need for good interlaboratory comparability as well as a need for harmonizing reporting results which will facilitate the exchange and interpretation of the data among the different laboratories carry out sampling and analysis. Coupled to this is a need to increase the technical capacities of some of the laboratories carrying out the sampling and analysis. Once the second stage has been implemented an exercise should be initiated to carry out a common sampling campaign. Bringing technical and scientific institutions together will help to build confidence and interest, thereby laying the foundation for cooperation in the management of the Sitnica - Ibar river system.

7.3 Environmental audit of KEK

As a recognized contributor of pollution to the Sitnica river, an environmental audit of KEK should be carried out as soon as possible in order to qualify and quantify the various sources of pollution from the complex. Such an audit will assist KEK and the authorities to establish a plan of action including time frames to reduce the pollution load to the environment.

In the long term this exercise should be extended to all other major industries in the Sitnica - Ibar catchment. This will help form the basis for a comprehensive environmental master-plan for reducing pollution and discharge loads in the catchment area of both rivers. Such environmental audits should be mandated by law as an integral part of measures to protect the environment.

7.4 Cadastre of industries/pollution sources

To complement the envirionmental audits, an inventory of all industries in he Sitnica - Ibar catchment area including abandoned plants/factories and non-point pollution sources should be carried out covering:

- Agricultural run-off;
- Hazardous substances;

- Microbiological contamination affecting water use;
- Heterotrophic growth and oxygen depletion affecting water use.

In the long term this information could be fed into a central environmental database which should be managed at the Kosovo and Serbia level and at a river basin level at a later stage.

7.5 Drinking water

In Kraljevo, improvements should include surveys to develop new wells at a safe distance from the riverbanks to avoid using suspect groundwater sources and at the same time closing down wells close to the river. A system of protective action distances based on a 3-tier system should be put in place which will help in decision-making when isolating wells suspect of being contaminated and facilitate the management of the supply of drinking water in a crises caused by accidental spills. Emergency water supplies should be available to the population living in the catchment areas as a contingency for accidental spills. The health effects of using well water for private households is a key concern in Pristina and a health survey of the population in affected areas should be drawn up and proper monitoring of water borne diseases should be established in particular those caused by microbiological contamination. An awareness campaign should also be carried out to instruct people on how they can render drinking water safe from this type of contamination. In the long term, as the quality of river water improves, private households should become less reliant on wells and change to a public system with the accompanying sewage treatment facilities.

7.6 Harmonized emergency plan for the Sitnica - Ibar river system

In the long term, there would be need for a programme focussing on preparedness measures for accidental spills and their consequences for the Sitnica - Ibar river system. From a practical standpoint, harmonized emergency plans for the whole watercourse will need to be developed. Serbia and Kosovo should be responsible for their own emergency plan. The framework will be jointly agreed. The emergency warning directed down stream will need to be adjusted accordingly to the time needed for steps to start the response measures downstream. The APELL process (Awareness and Preparedness for Emergencies at Local Level) developed by UNEP can be a useful model on which to base the development of such a plan. Annex 1 provides an outline

for a harmonized emergency plan for the Sitnica - Ibar river system. Importantly is the data that is generated in establishing the alarm network (Recommendation 7.2), the environmental audit (Recommendation 7.3), the inventory of pollution sources (Recommendation 7.4) which should be utilized in the preparation of the emergency plan.

7.7 Integrated River Basin Management

In the long term, there is a strong need for a broad, long-term environmental management and sustainable strategy for the Sitnica - Ibar river system and the entire catchment area. This should address the industries, other economic activities, cross-boundary economic development, social needs and increased co-operation. The objectives of the strategy should be to:

- secure prosperity for the people living in the river basin;
- sustainable use of the water resources including the introduction of adequate water and energy pricing policies;
- minimize environmental risks through pollution control measures and phasing-out discharges;
- preserving national and cultural values such as the establishment and registration of "protected areas";
- develop a participatory framework for cooperation between Kosovo and Serbia, communities and stakeholders in the river basin.

In this respect, before embarking on such a project, it would be worth getting in touch with River Commissions to learn from their experiences.

ANNEX 1

Outlines of a harmonized emergency plan the Sitnica - Ibar river system

1. Problems analysis and identification

1.1 Introduction
1.2 Definitions and terminology
1.3 Emergency scenarios
1.4 Emergency plan use

2. Harmonized emergency plan

2.1 Characterization of the area and its determination
2.1.1 Concise characterization of the river basin
2.1.2 Determination of the relevant part of the river basin
2.1.3 Characterization of the natural conditions related to protection of water against accidental spills
2.1.4 Organization responsible for the river basin

2.2 Emergency pollution of the Sitnica - Ibar watercourse
2.2.1 Water quality characterization of the watercourse in the river basin
2.2.2 Potential accidental spills to transboundary watercourse
2.2.3 Incidence of harmful/dangerous substances in the river basin
2.2.4 Inventory of the harmful/dangerous substances and their potential concentration in the cross border profile

2.3 Establishment of early emergency system
2.3.1 Organization aspects and communication
2.3.2 Water quality monitoring in the area
2.3.3 Emergency activities performance
2.3.4 Improvement of efficiency of emergency action in regional border profile

Annexes:

1. List of profiles of water-quality monitoring, emergency profiles proper for action and localities of emergency stores
2. Map of relevant drinking water supply sources, scale 1:200 000
3. Map of potential non-point and point pollution sources supported by agreed information, scale 1:200 00