UNEP

PHENOL SPILL IN SITNICA/SITNICE AND IBAR/IBER RIVER SYSTEM

UNEP/OCHA Assessment Report

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United Nations Environment Programme, UNEP/ Office for the Coordination of Humanitarian Affairs, OCHA

Assessment Mission

17 - 22 February 2003

REPORT

Geneva, April 2003

UNEP/OCHA Assessment - Phenol Spill in Sitnica/Sitnice and Ibar/Iber River System

REPORT

Table of Contents

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The mission is grateful for the full and open support of the national and local authorities in Kosovo and Serbia. Without such access to the relevant offices, facilities, local experts, information and the logistical support provided, the mission would not have been possible. The support provided by the United Nations Interim Administration Mission in Kosovo/Kosova (UNMIK) in Pristina/Prishtina in particular by the Environmental Protection Division as well as the other UN organizations including the UNDP Office in Belgrade proved essential for the successful implementation of the mission. Furthermore, the support by the Swiss Humanitarian Aid Unit and the German Technische Hilfwerk allowed for the efficient execution of the requested assessment.

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 Environment Unit requesting assistance with respect to recorded high levels of phenol in the Ibar/Iber river, a trans-regional waterway between Serbia and Kosovo/Kosova with its major upstream tributary - the Sitnica/Sitnice river. According to Serbian sources, the contamination caused interruptions to the drinking water supply in the city of Kraljevo. 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 for the assessment.

Given that the source of the contamination could have originated upstream in the Sitnica/Sitnice River, contact was also made by the Joint UNEP/OCHA Environment Unit with the United Nations Interim Administration Mission in Kosovo/Kosova (UNMIK) to investigate the possibility of extending the assessment into Kosovo/Kosova. 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 objectives of the mission were to conduct an assessment of the situation that may have led to the high phenol levels recorded in the Ibar/Iber river, to collect data related to the recorded high levels of phenol, and the environmental implications of such levels and to prepare recommendations for future action. The mission, as part of the work, conducted sampling, analysis and held discussions with national and local experts, national authorities, experts from UNMIK and local non-governmental organizations (NGOs). The mission lasted from 17 to 22 February 2003 and was conducted in two-parts with the mission first travelling to Pristina/Prishtina in Kosovo/Kosova and then to Belgrade and Kraljevo, the latter being the major area of concern within Serbia. The team was composed of four experts: an expert from Switzerland; one from Germany; and two representatives from UNEP, 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, it provided a preliminary overview of the emergency and its implications. It also represents a first step towards finding a long-term holistic solution to sustainable management of the Sitnica/Sitnice-Ibar/Iber watershed.

The range of expertise in the team included chemistry, ecotoxicology, water and sanitation engineering and environmental economics. In order to take advantage of existing UNEP 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/Sitnice - Ibar/Iber watershed

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

The total length of the river is 280 km. The Ibar/Iber river basin covers an area of 8,059 km^2. It drains the area of the mountain ranges of Kosovo/Kosova 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/Sitnice, the Ibar/Iber 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 Federal Republic of Yugoslavia (FRY) which in turn is based on the quality of receiving water after mixing with effluents. Accordingly, rivers (watercourses) are categorized in four classes. For each class, maximal allowable levels for certain water quality parameters are presented e.g., BOD, COD, coliform count, suspended solids, etc. It must be highlighted that this type of approach has been abandoned in Western Europe and North America and replaced 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/Iber and its tributaries were analyzed at three locations: Raška, Ušće and Kraljevo. Near Raška, the water contained organic matter that caused oxygen deficiency and a high biochemical oxygen demand. Near Ušće and Kraljevo, the quality of water improved as a result of natural processes and by the dilution effect of water from the tributaries feeding into the Ibar/Iber river.

3.2 The industrial complex in Obiliq/Obilić - KEK power plants

A major source of pollution in the region of Pristina/Prishtina in Kosovo/Kosova is the Korporata Energjetike Kosovës (KEK) industrial complex in Obiliq/Obilić. This complex was designed to produce, electricity, gas, fertilizer and dry coal from open pit lignite mines. The main sources of emissions are: lignite open pit mines; power generation and the lignite drying plant. In the past, the gasification and fertilizer plants were also sources of pollution but these were permanently closed down in 1988-1989. The drying plant has not been functional over the last three years.

The lignite deposits in the region are considered to be the second largest in Europe and their exploitation for generating energy has been going on for a long time. The energy generating process is based on the "Lurgi" technology of the 1950s which today is rarely applied due to its high pressure on the environment.

The power plants in Obiliq/Obilić are considered a major source of pollution in the areas of Pristina/Prishtina and beyond with significant emissions of sulphur dioxide, nitrogen oxides, dust, fly ash, smoke, radioactive particles and carbon gases which are not monitored. In addition to these atmospheric emissions, there are also effluents discharged to the Sitnica/Sitnice river containing a cocktail of substances including phenols which is a by-product of the gasification process as well as naturally present in lignite.

3.3 City of Kraljevo

The city of Kraljevo, located some 200 km north and downstream from Pristina/Prishtina, is an important administrative and industrial centre in Central Serbia - Centre of Raška county. According to the 2002 census, the population of Kraljevo is 57,761 inhabitants , the municipality has a population of 122,035, and Raška county, comprising of 5 municipalities, has a population of 290,816.

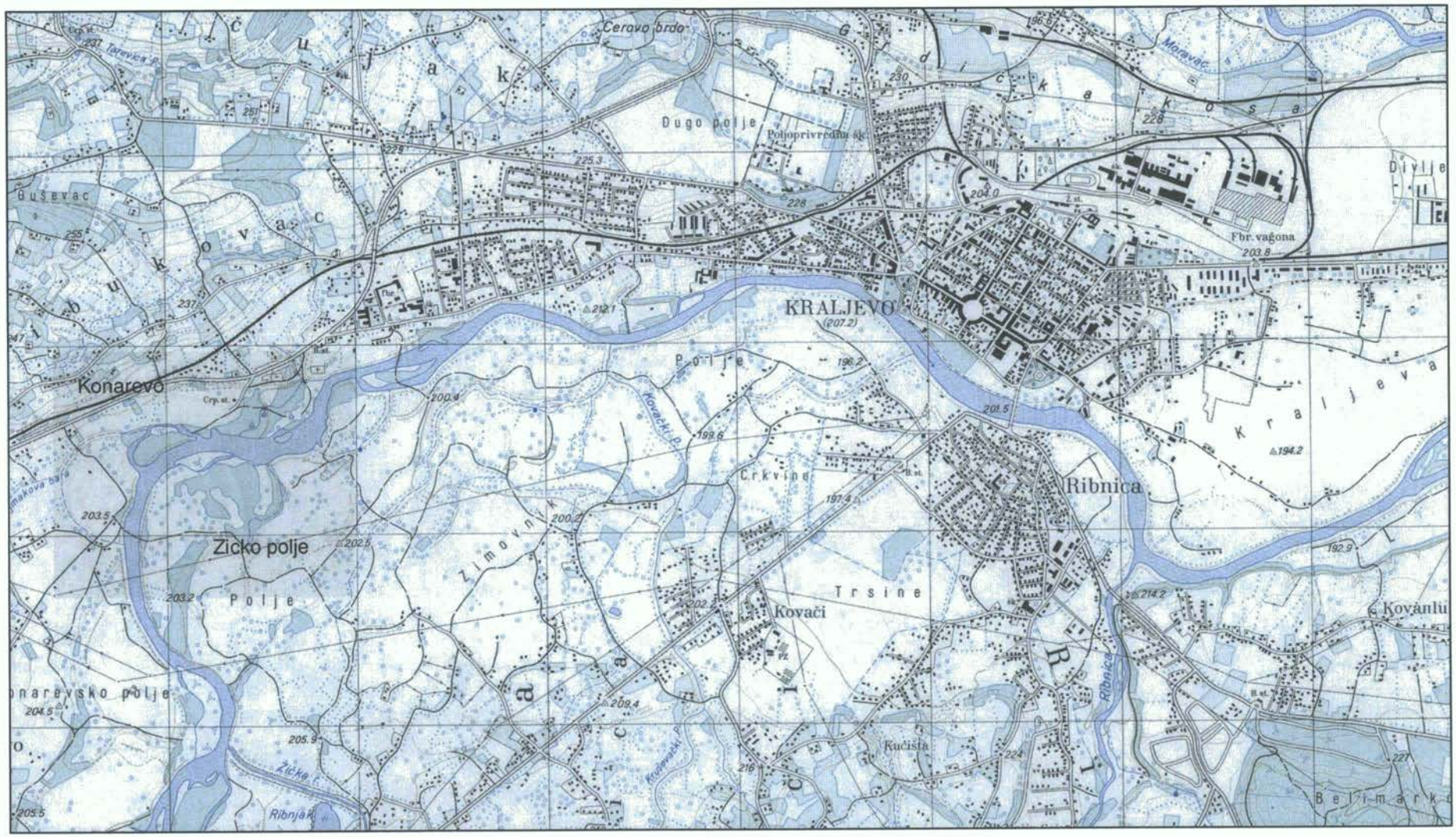
There are approximately 25,000-30,000 IDPs (internally displaced people) from Kosovo/Kosova and Metohija living in the municipality of Kraljevo. Since the middle of the last century the city of Kraljevo has relied on the Ibar/Iber river for its drinking water supply. The first well (Djeriz) was

connected by a German company in 1937 on the left bank of the river Ibar/Iber close to the city centre and a second (Streliste) was connected in 1942, 2 km downstream on the same bank.

The city of Kraljevo uses groundwater from alluvial deposits. Groundwater recharge is mostly due to river bank filtration of Ibar/Iber river water, although there is recharge due to underground inflow from the upgradient zones of the alluvium. Natural groundwater flow is in the same general directional flow of the river Ibar/Iber. Groundwater resources in the zone of the city present an optimal resource for water supply.

The layout of existing source fields for the drinking water supply of Kraljevo indicates 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/Iber river **(see Figure 1).**

Figure 1 - General map of Kraljevo showing the two water catchment areas, Konarevo and Zicko Polje



4. FACTS ON PHENOL

The assessment mission focussed primarily on the phenol problem in view of a detected increase of phenol concentration in the Sitnica/Sitnice and Ibar/Iber river system. However, in view of the concern of other potential sources of pollution into the river system, the assessment also considered the issue of phenol within the larger perspective of other pollution sources discharging into the river.

Main characteristics of phenol of interest to the assessment.

(Source: Handbook of Environmental Data on Organic Chemicals edited by Karl Verschuren. Van Nostrand Reinhold, N.Y., 1983).

Solubility in water:	82 g/l at 15°C	
Saturation conc. in the area:	0.77 g/m^3 at 20°C; 2.0 g/m^3 at 30°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°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	

In summary, phenol is toxic if ingested in high dosage. In the environment, the product is slowly biodegraded by autooxidation or by photooxidation. Phenol is also a by-product of carbohydrate human metabolism and is therefore excreted. This means that the compound will be found in domestic wastewater and subsequently in surface waters receiving untreated domestic wastewater effluents.

The chlorination of water for disinfection, containing low concentrations of phenols (μg/l) could form chrolophenols. Although a theoretical possibility, this is highly unlikely in circumstances of low temperatures such as, for example, at the temperatures of water in water pumping stations.

5. PREVIOUS SPILLS OF PHENOL

As early as 1966-1967, there were indications that the water quality in the Ibar/Iber river was deteriorating. In the late seventies, phenol was found to be present in the Ibar/Iber river. At the same time, no systematic monitoring of the water quality in the river Ibar/Iber was in place.

Accidental pollution by phenols to the Ibar/Iber river and its upstream tributary, the Sitnica/Sitnice river, was first registered in 1983. During 1984 and 1985, concentrations of phenols were for the most part above the maximum allowable value of 1µg/l established by FRY. The concentrations detected ranged between several microgram per litre to several hundreds with the resulting concentrations in groundwater (used for the water supply of Kraljevo) in the order of tens of micrograms per litre.

The use of groundwater for the drinking water supply of Kraljevo has been interrupted a number of times in the 1980s. The decrease in industrial activities during the 1990s 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 and the consequent conclusions and recommendations are based on two main sources; background reports provided by the authorities in both Kosovo/Kosova and Serbia and information collected by the UN mission.

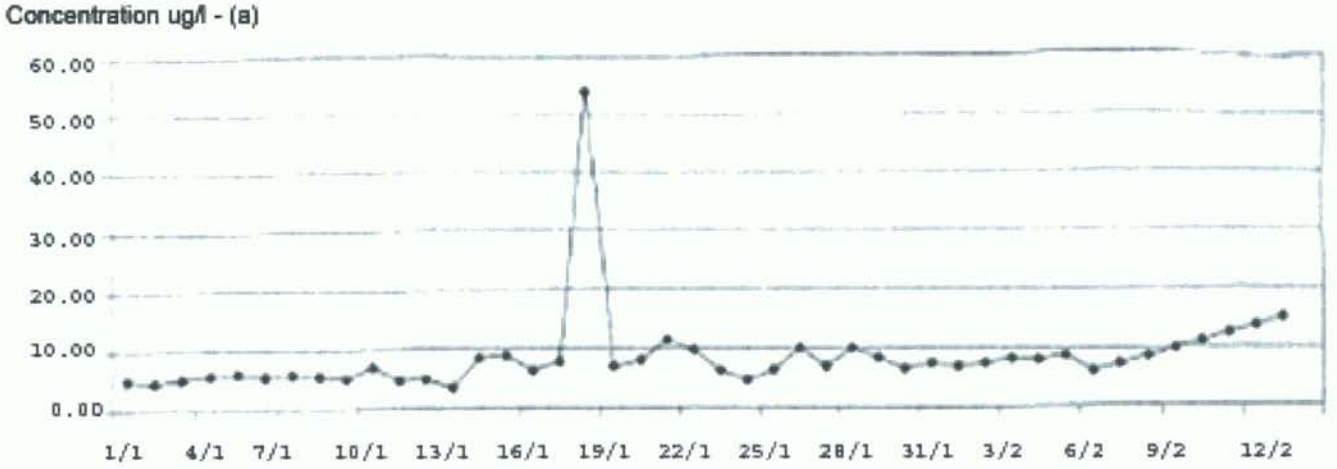
6.1 High levels of phenol in the Ibar/Iber-Sitnica/Sitnice river system in January 2003

6.1.1 Initiatives taken by the Serbian authorities

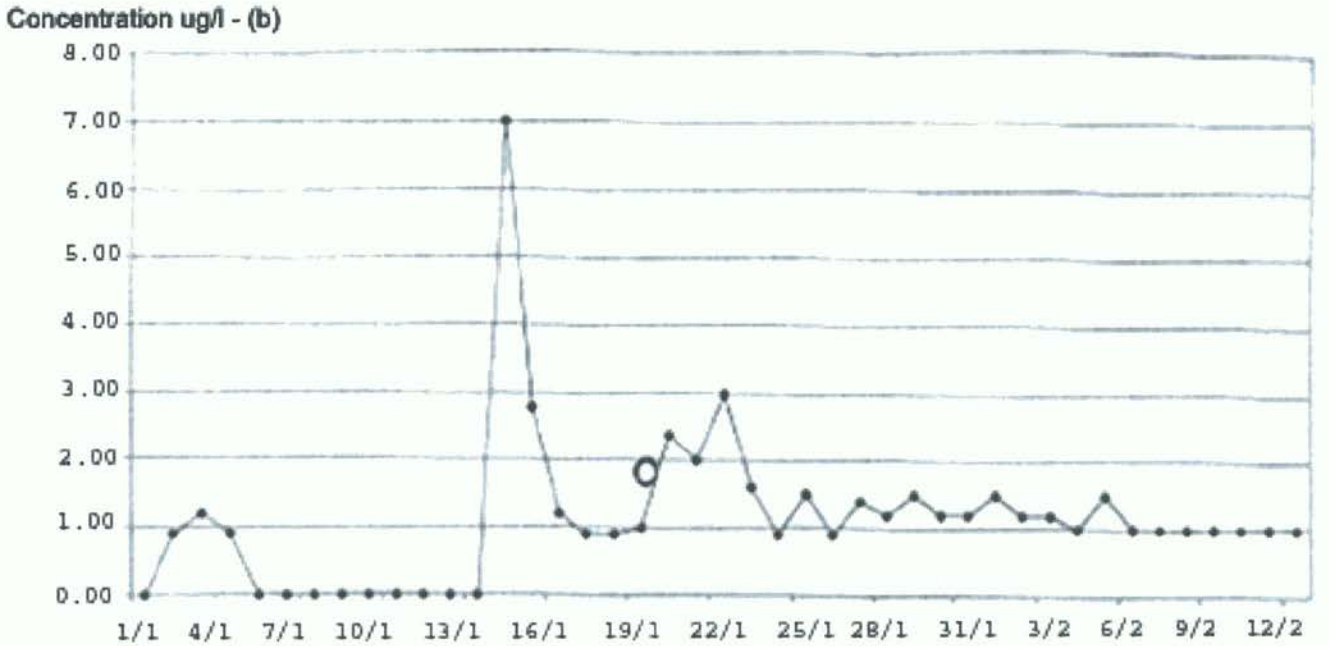
On 14 January, analysis carried out by the Hydrometeorological Institute of the Republic Serbia, (RSHMI), as part of the Ibar/Iber river regular monitoring water quality programme, showed phenol concentrations higher than the norm along the river. This prompted the authorities to conduct more frequent sampling and analysis along the Ibar/Iber river system. Results did show pulses of phenol concentrations in the river Ibar/Iber water above the maximum allowable concentration. From 14 to 17 January, the results of the analysis indicated that the concentrations of phenol were returning to the usual values for the Ibar/Iber 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. which dropped to 5.9 µg/l by 10 p.m. The increased frequency of monitoring continued until 12 February after which monitoring of water quality continued as per normal as concentrations of phenol decreased and returned to the usual values.

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

Figure 2 a) and b): The graphs provided by MPNRE, show the results of the monitoring programme between January and mid-February 2003. It must be noted that Raška is upstream and water takes approximately 26 to 36 hours to reach Kraljevo which is found downstream. (Note: concentration in µg/l are different in the scales for the two graphs)



Registered concentrations of phenol in the river Ibar/Iber water at Raska during the period: 1 January to 14 February 2003



Registered concentrations of phenols in the river Ibar/Iber water at Kraljevo and Mataruska Banya - **O** - during the period: 1 January to 16 February 2003

One initiative taken by the MPNRE was the establishment of a team of experts to survey the industrial facilities of Obiliq/Obilić, primarily the Korporata Energjetike Kosovës (KEK), focussing on the gasification facilities since the Serbian authorities felt that these represent the major source of phenol pollution in the Sitnica/Sitnice river. The significant quantities of phenol stored were considered to present an even greater risk of pollution than the one presently observed, should the storage tanks leak. In coordination with the UNMIK administration, this survey was conducted on 23 January 2003. Water samples at key locations along the river were also taken. The phenol concentrations were found to be considerably higher than the maximum allowable value for phenol established by FRY. The team of Serbian experts also drew up preliminary proposals for potential risk reduction and remediation measures. The UN mission was provided with a copy of the report which reviewed it contents. This provided background information.

On January 27, the Minister for the Protection of Natural Resources and Environment also held a meeting with representatives of the local government of Kraljevo and with the chief of Raška county to initiate finding a long-term solution to the potable water supply problem for the city of Kraljevo. In 2001-2002, a proposal was made to the municipality, within the framework of the Swiss Development and Cooperation Agency (SDC) Ecology Projects, aimed at investigating new groundwater resources.

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/Kosova in the Ibar/Iber river downstream of Mitrovica/Mitrovicë. This initiated an intense sampling campaign by the Hydrometerological Institute of Kosovo/Kosova (KHMI) in the river Sitnica/Sitnice from Vragoli/Vragolija to Mitrovica/Mitrovicë. Over the next few days, high concentrations were found in the vicinity of the KEK power plants. Concentrations later decreased but high phenol concentrations were again detected on January 24 at the same locations.

On January 25, a 2-week monitoring plan was agreed to by the KEK management, MESP and the Department of Environment (DoE) of the Provisional Institutions of Self Government and International Environment Advisors of UNMIK and carried out by the KHMI. The monitoring plan

included sampling all inflows into Sitnica/Sitnice river and numerous point source within the KEK complex **(see Figure 3).**

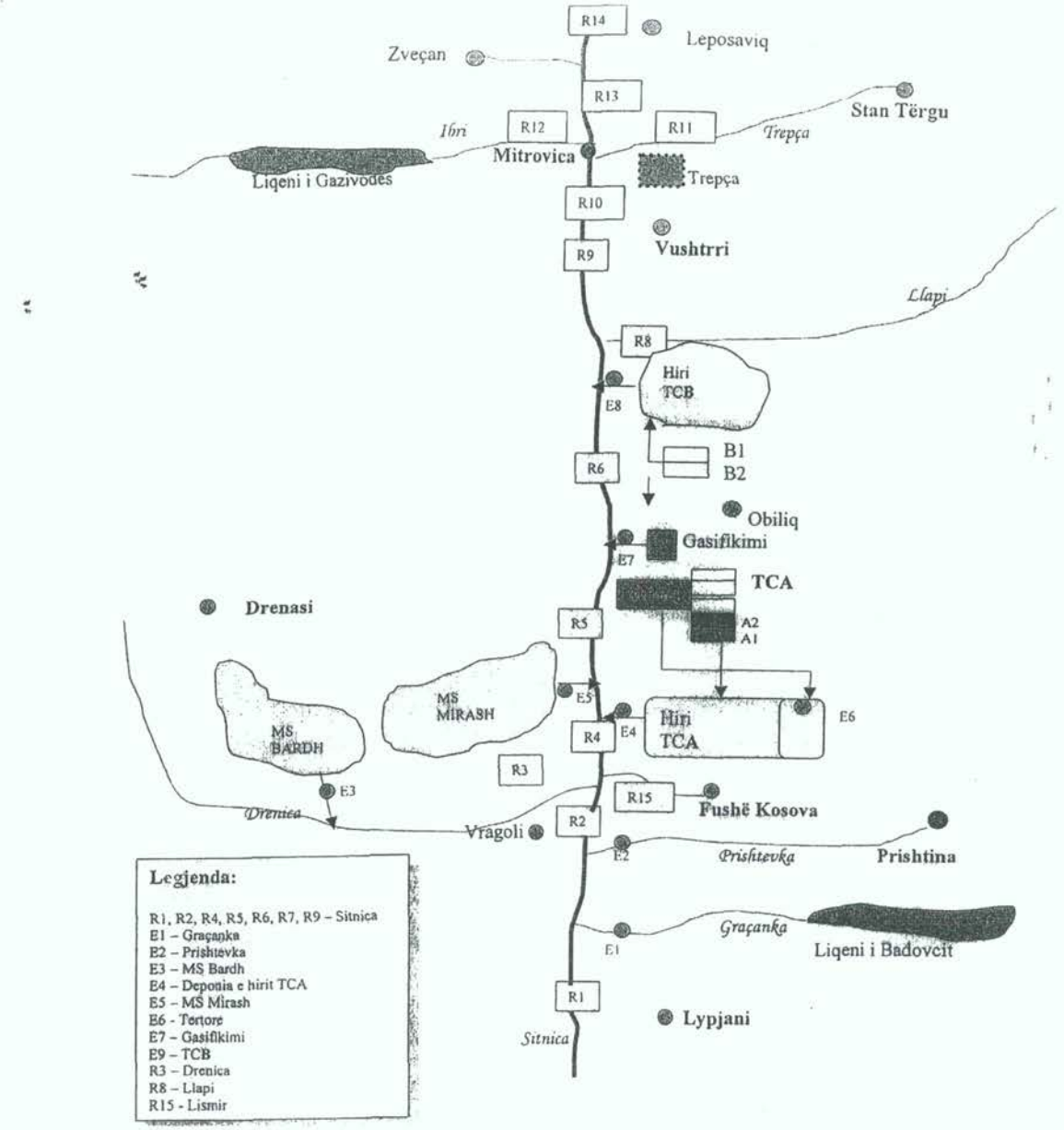


Figure 3: Locations of the sampling campaign carried out by KHMI (map provided by KHMI)

A working group of experts was also formed by MESP to find a permanent solution to dispose off the concentrated phenol and phenol wastewaters stored in the gasification facilities of KEK. In addition, on January 20, 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/Sitnice river.

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

The brief qualitative survey along the Sitnica/Sitnice - Ibar/Iber river system conducted by the UN mission as well as discussions with the local experts indicate long term environmental degradation due to, agricultural run-off, direct discharge of domestic wastewater and solid waste thereby contributing to eutrophication of the river.

In addition, the UN mission was informed of ongoing sources of pollution into the river system from other sources such as the seed-oil factory in Ferizaj/Lipljan, a paper factory and a bottling plant in Lipjan, the Mitrovica/Mitrovicë industrial complex, etc. As with the domestic wastewater, untreated industrial effluents are discharged into the rivers. Considering that the process technologies in use in some of these industrial complexes located within the catchment area of the Sitnica/Sitnice - Ibar/Iber river system are not "environmental friendly", a cocktail of industrial pollutants will reach the river system.

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

- high inputs of organic matter leading to eutrophication;
- hydrological and physical changes caused by untreated waste discharge;
- siltation from inadequate erosion control;
- contamination from industrial and domestic sources.

The ecosystem has been subjected to a number of modifications and environmental impacts resulting in vulnerabilities prior to the current accident. Indeed, the change of a natural ecosystem due to such influences is not unique to this river system but is also a problem of other water bodies in the region as well as of other Eastern European rivers.

6.3 Korporata Energjetike Kosovës (KEK)

Built in the early 1970s, KEK is a large industrial complex which produced gas, electricity and dry coal. The company faces the quandry of having to strike a balance of producing energy with limited pollution effects at the same time using outdated technology. Lignite extracted from open pit mining serves as a combustible solid to fire the power plants. Presently, only the lignite mines and

the power plants are in operation. Due to the size of the complex and the scope of the UN mission, it 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 are:

- Lignite mines
  - Surface water pumped to the river
  - Internal gases
- Drying plant (not in operation)
  - Condensate water
- Gasification facilities (not in operation)
  - Phenol water
  - Ammonium water
- Power plants
  - Fly ash
  - Bottom ash
  - Flue gases
- Ash landfills
  - Contaminated water that percolates through the landfills
  - Dust particles
- Contaminated soil
  - Contaminated leachate

Although it has not been determined how much of the burnt lignite remains in the form of ash, it has been reported[1] that 95% of all ash produced by coal combustion utilities is composed of oxides of silicon, aluminium, iron and calcium. Ash also contains many other trace elements that vary by type and level depending on particle size, source of the coal and other factors. These elements include arsenic, barium, cadmium, copper, lead and mercury and strontium, some of which could be radioactive. Many are in the form of oxides chemically bonded as complex silicates. The UN mission observed that large expanses of land are impacted by the open pit mines and from the use of land surface for ash landfills.

[1]U.S. Congress, Office of Technology Assessment, Managing Industrial Solid Wastes from Manufacturing, Mining, Oil and Gas Production and Utility Coal Combustion - Background Paper, OTA-BP-0-82 (Washington, DC: US Government Office, February 1992)

Figure 4: Ash landfills

Due to this heritage of the past thirty years, KEK has contributed to chronic contamination of the soil, water and air that originates mainly from lignite exploitation and unmanaged combustion utility waste generation.

In addition, concentrated phenol and phenolic water are stored in large tanks in the vicinity of the gasification facilities. The storage tanks are in relatively good condition with no severe corrosion damage observed although a faint smell of phenol could be detected close to the tanks and around the manholes close to the pilot biological waste water treatment plant (not in operation). Visual inspection of the valves of the tanks showed that they too are also in relatively good condition although the electrical installation is in disrepair. A proper survey of the tank piping system and pumps would need to be carried out should any plans be undertaken to empty the tanks.

Figure 5: Storage facilities for phenolic waters at KEK

In conclusion, a number of potential sources of phenols were identified within KEK related to: the pumping of water from the mines, leaching of water from ash landfills and the risk of release of polluted water from the gasification facilities. There is therefore a need for a detailed environmental audit of the KEK in order to obtain a clearer picture of the pollution sources and the extent of their contribution to the overall phenolic problem in the Sitnica/Sitnice river.

6.4 Evaluation of local analytical capacity

In order to evaluate the information provided to the mission, the UN mission visited local laboratories and discussed analytical approaches and methods with technicians and scientists to ensure that data that are being generated are reliable and that an appropriate data quality control system is placed in each of the laboratories. The visits also proved useful in obtaining historical information on the contamination of the river by other substances in addition to phenol.

In Kosovo/Kosova, different institutions were involved at some stage in the analysis of phenols:

- INKOS (a monitoring and research entity of KEK) which among its responsibilities monitors water quality within the industrial complex;
- KHMI (Hydrometerological Institute of Kosovo/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.

In the Republic of Serbia, different institutions were also involved in the monitoring of phenol:

- RSHMI (Hydrometerological Institute of the Republic of Serbia);
- the Institute of Public Health of Kraljevo (IPH).

Competencies of these institutions are similar to those in Kosovo/Kosova. However, the UN mission was informed that when high phenol levels were registered in January, the analysis for drinking water was done by the Institute of Public Health at a laboratory in a nearby town.

The UN mission sampled selected locations along the Sitnica/Sitnice-Ibar/Iber river system. Simultaneously, parallel samples were also taken by personnel from the different laboratories

responsible for the analysis of the river water. The purpose of this exercise was not to obtain a representative overview of water quality or to identify baseline contamination in the area but to see if comparable data could be generated by the different entities carrying out sampling and analysis. Samples collected by the UN mission were sent to an independent laboratory in Switzerland which analyzed for total phenol at all sampling sites, derivatives of phenol and total concentration of key heavy metals for one of the sampling sites **(see Annex I).**

Phenol concentration in water is determined according to "standard analytical procedures" for measuring the phenol index. With the exception of the Institute of Public Health in Kraljevo, which uses a gas chromatographic method, a colorimetric method is used by the laboratories to measure total extractable phenols. The UN mission found that despite the uncertainties that may exist due to different sampling techniques, the different and quality of instrumentation and human resource capability, the results that are generated could be used to establish a first warning when pollutants such as phenol are detected in the river. The results given in **Annex I** clearly show that a need exists for interlaboratory cross-checking and capacity building of laboratory personnel to ensure reliability and quality of analytical results. A detailed analysis of the chemical procedures used, the historical laboratory records and the method of equipment calibration would be needed, to understand better the discrepancies among the results obtained by different laboratories.

Figure 6: Sampling point (leachate from the ash landfill) within KEK complex

6.5 Drinking water

In Pristina/Prishtina and nearby villages, some private homes have their own wells that are often shallow, making them vulnerable to surface pollution and pollution from Sitnica/Sitnica river groundwater bed.

Results of phenol concentrations obtained by NIPH for 20 January and 17 February show that:

- In January 20, all the wells were registering phenol concentrations higher that the maximum admissible established by NIPH for drinking water;
- By February 17, all phenol concentrations had decreased appreciably with no risk or threat to human health.

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

As stated earlier, Kraljevo is supplied by a network of wells feeding into two main pumping stations: Konarevo on the left bank and Žičko polje on the right bank of the Ibar/Iber river. A visit of the UN mission to a pumping station indicated that it was in good technical working condition including pumps, chlorination system, etc., and operated by skilled technical personnel. However, the reservoir for water storage was leaking and the internal lining was not in good condition.

Figure 7: Pumping station visited by the UN mission in Kraljevo

The Kraljevo wells are for the most part located far enough away from the Ibar/Iber riverbed. Thus, for these wells, the process of filtration and siltation by alluvial deposits will reduce the concentrations of pollutants on their way to the wells. However, some wells are located in close proximity to the riverbed (mainly in the Konarevo field). According to the results of hydrodynamic modeling of Kraljevo groundwater resources, these wells have a delay time of only 5 - 6 days and are the ones most susceptible to rapid breakthrough of pollutants that may exist in the Ibar/Iber river.

Results obtained from the different entities involved in water quality monitoring show that over the past years the phenol concentrations in Kraljevo potable water supply never reached harmful levels for human health. This was also confirmed by an independent study carried within the framework of the SDC Ecology Projects (Project A8, 2001-2002). The water quality of the Ibar/Iber river can be improved but not as long as industry and the local communities continue to discharge their wastewater 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 assimilative capacity.

From the examination of the results of the phenol concentrations in the Ibar/Iber river during the period of concern (January-February), the UN team concluded that the major peak of phenol concentration observed at the sampling point in Kraljevo on 14 January cannot be linked to any phenol released upstream in the Răska area. On the other hand, the peaks observed in Kraljevo between 20 to 21 January can be linked to phenol in the Răska area on 18 January (**see Figure 2 a and 2 b - in Section 6.1.1**).

These results signify the following:

i. The first pulse of phenol detected around the 14 January in Kraljevo could have probably originated from a source between Răska 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.

6.6 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.

6.7 Summary of findings

The findings of the assessment are:

- The Sitnica/Sitnice - Ibar/Iber catchment is significantly polluted by domestic and industrial waste water due to a lack of municipal and industrial wastewater treatment facilities as well as an inadequate waste management strategy;
- Indications are that KEK contributes significantly to the pollution of the Sitnica/Sitnice river although the extent of which has yet to be determined;
- Other significant sources of phenol to the Sitnica/Sitnice river exist such as the city of Pristina/Prishtina, the Mitrovica/Mitrovicë industrial complex, etc.;
- The highest concentration of phenol in the Ibar/Iber river recorded in January is not necessary attributed to releases of phenol upstream in the Sitnica/Sitnica river;
- During the January period, the drinking water supply of Kraljevo was not endangered by the elevated phenol concentrations registered in the Ibar/Iber river.

7. RECOMMENDATIONS

The UN mission was limited in time and scope. Its findings and recommendations are designed to provide for finding a long-term holistic solution to sustainable management of the Sitnica/Sitnice - Ibar/Iber watershed. The following recommendations should therefore be seen in this vein. Furthermore, the long history and use of outdated industrial technologies, as well as the socio-economic and political situation prevailing in the area would require that these recommendations are implemented in phases.

7.1 Information

The systematic sharing of information between stakeholders in the Sitnica/Sitnice - Ibar/Iber watershed can serve as a basis for better co-operation. In this respect, it is important to note that there is a need for improved information exchanges especially among the Serbian authorities, the population of Kraljevo and NGOs. Citizens of Kraljevo are well aware that pollution by phenol has occurred in the past and there is a general mistrust of the information being disseminated by the authorities when pollution incidents occur and of the overall water quality of the Ibar/Iber river. Engaging civil society at the earliest stage will improve the quality of decision-making and strengthen credibility of the decision-making process and the resulting outcome.

7.2 Alert network

In the short-term, based on the existing monitoring plans, an alert network should and can easily be put in place at the river basin level (Sitnica/Sitnice and Ibar/Iber) which can serve as an early warning mechanism downstream as soon as sudden releases of hazardous substances in the Sitnica/Sitnice - Ibar/Iber river are detected. All stakeholders should be included in this network e.g., authorities and industries. Minimum requirements necessitate the development of a management plan which includes:

- development of alerting and fan-out procedures including the preparation of a standard format for the notification and reporting of results between the different entities;
- development of clear and concise communication procedures between the different entities including the establishment and maintenance of an updated list for contacting individuals on a 24 hour basis;
- definition of a clear decision-making chain in order to take the appropriate response measures.

Such an alert system will not reduce the pollution but give enough time to the authorities to decide on whether to shut down the wells at risk. 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. Coupled to this is a need to increase the technical capacities of some of the laboratories. An exercise should then be initiated to carry out periodic common sampling campaigns. 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/Sitnice - Ibar/Iber river system.

7.3 Environmental audit of KEK

As a recognized contributor of pollution to the Sitnica/Sitnice river, KEK should carry out an environmental audit 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. This will help form the basis for a comprehensive environmental master-plan for reducing pollution and discharge loads. Such environmental audits should be mandated by legislation as an integral part of measures to protect the environment.

7.4 Cadastre of industries and potential pollution sources

To complement the environmental audit, an inventory of all industries including abandoned plants/factories and non-point pollution sources should be carried out covering:

- Contaminated sites;
- Emissions, storage and dumpsites for hazardous substances;
- Agricultural run-off.

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

7.5 Drinking water

In order to improve quality of drinking water in Kraljevo, it is recommended that:

- Surveys be carried out in order that new wells could be constructed at a safe distance from the riverbanks at the same time allowing wells to be closed in the vicinity of the river to avoid suspect groundwater sources;
- a system of protective 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 drinking water supply in a crisis caused by accidental spills;
- emergency water supplies should be available to the population living in the catchment areas as a contingency for accidental spills.

Since, the health effects of using well water for private households is a key concern in Pristina/Prishtina, it is recommended that:

- a health survey of the population in affected areas should be drawn up;
- proper monitoring for water borne diseases should be established in particular those caused by microbiological contamination;
- an awareness campaign should be carried out to instruct people on how they can render drinking water safe from microbiological contamination;

- as the quality of river water improves, systems should be put in place so that private households become less reliant on wells and transfer to a public system with the associated sewage treatment facilities.

7.6 Harmonized emergency plan for the Sitnica/Sitnice - Ibar/Iber river system

There is a need for a programme focussing on preparedness measures to be established. To ensure long term protection and improve management of accidental spills and their consequences for the Sitnica/Sitnice - Ibar/Iber river system, it is recommended that:

- harmonized emergency plans for the whole watercourse are developed;
- Serbia and Kosovo/Kosova should be responsible for their own emergency plan; the framework of which should be jointly agreed;
- the emergency alert directed downstream 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 II provides a preliminary outline for a harmonized emergency plan for the Sitnica/Sitnice - Ibar/Iber river system. The following should be utilized in the preparation of the emergency plan:

- the data that are generated for the establishment of the alert network (Recommendation 7.2);
- the data that are generated in the environmental audit (Recommendation 7.3);
- the data are generated in the preparation of the inventory of potential pollution sources (Recommendation 7.4).

7.7 Integrated river basin management

In the long term, there is a need for a broad, long-term environmental management and sustainable strategy for the Sitnica/Sitnice - Ibar/Iber river system and the entire catchment area. This should address the industries, other economic activities, cross-regional 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/Kosova 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 I

Table I - Comparative analytical results of phenols (measured as phenol index)

Sampling location	R1	E1	E4	E5	R12	R13	Ibar in Kraljevo	KV2 Kraljevo (Pumping Station)	Quantification limit for RWD	Detection limit for RWD
Position of sampling	N 42°30'47,7" E 21°06'44,6"	N 42°36'39,3" E 21°04'3,9"	N 42°40'15" E 21°05'26,5"	N 42°39'57,7" E 21°04'05,7"	-	-				
Date of sampling	18.02.03	18.02.03	18.02.03	18.02.03	18.02.03	18.02.03	21..02.03	21.02.03		
RWB, Switzerland	< 5µg/l	< 5µg/l	< 5µg/l	< 5µg/l	< 5µg/l	< 20µg/l*	< 5µg/l	< 5µg/l	< 10µg/l	< 5µg/l
Institute of Hydrometeorology of Kosovo	< 25µg/l	36µg/l	750µg/l	118µg/l	<25µg/l	<25µg/l	-	-		
INKOS	0.00µg/l	15µg/l	7µg/l	4µg/l	3µg/l	4µg/l	-	-		
Institute of Public Health of Kraljevo	-	-	-	-	-	-	< 1µg/l	< 1µg/l		
Institute of Hydrometeorology of Kraljevo	-	-	-	-	-	-	<1µg/l	-		

**Quantification limit is 20 µg/l since the analytical method used for this particular sample was Inductively Coupled Plasma Mass Spectrometry (ICP-MS).*

Table II - Analytical results for phenol derivatives at sampling location R13

Sampling point	**R13**
Date of sampling	18.02.03
Date of analysis	26/02/03 for the index 5/03/03 for the derivatives
Laboratory: RWB, Switzerland	
Method: **phenol index according to T90-109** **GC - MS for derivatives according to EPA 525, 625**	

	Results	**Quantification limit**	**Maximum allowable limits for water quality according to legislation of the Republic of Serbia**	**Maximum allowable concentration for water quality as stipulated by EU Directives**
Phenol index	< 20 µg/l	20 µg/l	-	-
2-Chlorophenol	< 20 ng/l	20 ng/l	-	exempt*
Phenol	< 200 ng/l	200 ng/l	1 µg/l	1000 µg/l
2-Methylphenol	< 20 ng/l	20 ng/l	50 µg/l	400 µg/l
3-Methylphenol/ 4-Methylphenol	<40 ng/I	40 ng/I	2 µg/l	200 µg/l / 120 µg/l
2-Nitrophenol	< 40 ng/l	40 ng/l	60 µg/l	-
2,4-Dimethylphenol	< 20 ng/l	20 ng/l	-	-
2,6-Dichlororophenol	< 20 ng/l	20 ng/l	-	35 µg/l
2,4-Dichlorophenol	< 20 ng/l	20 ng/l	2 µg/l	10 µg/l
4-Cholro-3-methylphenol	< 20 ng/l	20 ng/l	-	n.d.**
2,4,6-Trichlorophenol	< 20 ng/l	20 ng/l	0.4 µg/l	1 µg/l
2,4,5-Trichlorophenol	< 20 ng/l	20 ng/l	-	1 µg/l
2,4-Dinitrophenol	< 100 ng/l	100 ng/l	30 µg/l	-
4-Nitrophenol	< 100 ng/l	100 ng/l	25 µg/l	-
2,3,4,6 Tetrachlorophenol	< 40 ng/l	40 ng/l	-	-
2-Methyl-4,6-dinitrophenol	< 40 ng/l	40 ng/l	-	-
Pentachlorophenol	< 100 ng/l	100 ng/l	300 µg/l	1 µg/l
2-sec-Butyl-4,6-dinitrophenol (Dinoseb)	< 100 ng/l	100 ng/l	-	-

exempt* = Propose to be exempted from list 1 by the Scientific Committee on Toxicity, Ecoloxicity and the Environment (CSTEE) - Ref.: CSTEE/EEC (1994) EEC: Water quality objectives for chemicals dangerous to aquatic environment (List 1) in Reviews of Environmental Contamination and Toxicology

n.d.** = 4 chloro-3-methyl phenol has been reviewed by the CSTEE but a limit value has yet to be determined

Table III - Analytical results for total heavy metal concentrations at sampling location E4

Sampling point	E4
Position of sampling points	N 42°30'47,7" E 21°06'44,6"
Date of sampling	18.02.03
Date of analysis	**26.02.03**
Laboratory RWB Switzerland	
Method: ICP-MS	

Cadmium (Cd)	0.0016 mg/l (+/- 5%)
Copper (Cu)	0.016 mg/l (+/- 5%)
Lead (Pb)	0.00009 mg/l (+/- 0.00002%)
Strontium (Sr)	0.49 mg/l (+/- 5%)
Zinc (Zn)	6.8 mg/l (+/- 5%)

ANNEX II

Proposed outline of a harmonized emergency plan the Sitnica/Sitnice - Ibar/Iber 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/Sitnice - Ibar/Iber 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