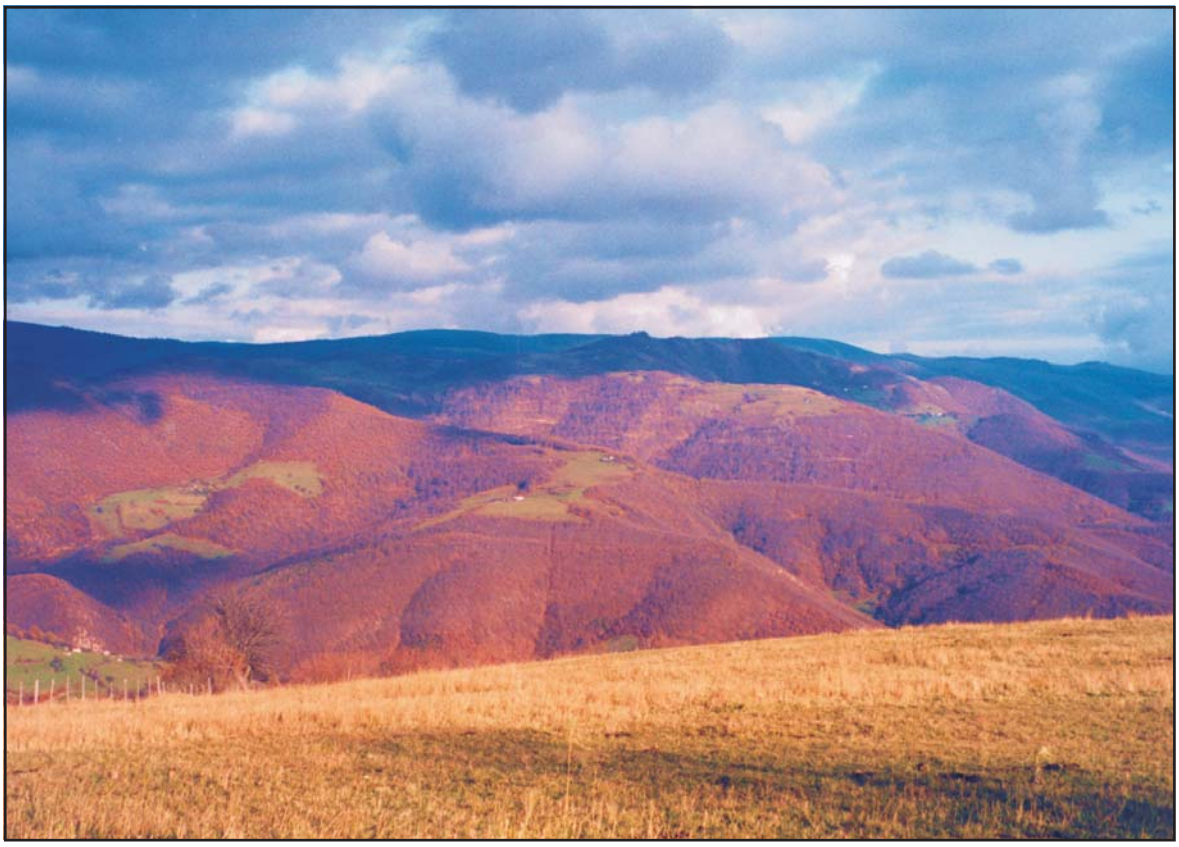


From Conflict to Sustainable Development

Assessment of Environmental Hot Spots

Serbia and Montenegro

April 2004

UNEP

Ministry for Science and Environmental Protection of the Republic of Serbia
Ministry of Environmental Protection and Physical Planning of the Republic of Montenegro
United Nations Environment Programme

First published in Switzerland in 2004 by the United Nations Environment Programme.

ISBN 92-807-2439-6

Job No.: DEP-0524-GE

United Nations Environment Programme
PO Box 30552
Nairobi
Kenya
Tel: +254 2 621234
Fax: +254 2 624489/90
E-mail: cpiinfo@unep.org
Web: http://www.unep.org

Ministry for Science and Environmental Protection
Directorate for Environmental Protection
Dr. Ivana Ribara 91, 11070 Novi Beograd
Republic of Serbia
Tel: +381 11 3616-368
Fax: +381 11 2158-793
E-mail: ekabin@ekoserb.sr.gov.yu
Web: http://www.ekoserb.sr.gov.yu

Ministry of Environmental Protection and Physical Planning
PC Vektra, 81000 Podgorica
Republic of Montenegro
Tel: +381 81 482121
Fax: +381 81 234131
E-mail: ministar.ur.pr.@cg.yu

DISCLAIMER

The contents of this volume do not necessarily reflect the views of UNEP, Ministry for Science and Environmental Protection of the Republic of Serbia, Ministry of Environmental Protection and Physical Planning of the Republic of Montenegro, or contributory organizations. The designations employed and the presentations do not imply the expressions of any opinion whatsoever on the part of UNEP, Ministry for Science and Environmental Protection of the Republic of Serbia, Ministry of Environmental Protection and Physical Planning of the Republic of Montenegro, or contributory organizations concerning the legal status of any country, territory, city or area or its authority, or concerning the delimitation of its frontiers or boundaries.

Report Editing: John Bennett
Design and Layout: Matija Potocnik
Maps: UNEP/PCAU
Cover Photo: Roeland Kortas - UNOPS
Photos: UNEP/PCAU
Printer: SRO-Kundig SA, Switzerland
Printed on Recycled Paper

TABLE OF CONTENTS

FOREWORD

Serbia & Montenegro, like many countries, is faced today with the serious challenge of integrating environmental considerations into the country's pressing economic, social and political priorities. Efforts to improve environmental legislation and harmonize it with EU legislation are under way. Environmental action plans to identify and implement priority action, on the local as well as national levels, have been elaborated and priority actions initiated. South Eastern Europe as a whole has turned its back on the violence and conflict which caused such pain and suffering and stifled economic development and is now rightly looking forwards to a peaceful and successful European future.

In response to the Kosovo conflict in 1999, United Nations Environment Programme (UNEP) and its partners have worked to assess and remedy a number of Serbia & Montenegro's most urgent environmental problems. The UNEP Clean-Up Programme has during the past four years remediated site-specific, conflict-related risks at four "hot spots" and strengthened institutional capacity in a number of important areas.

As an integral part of the closure of UNEP's post-conflict activities in Serbia & Montenegro and the handover of the Clean-Up Programme to Serbian authorities in the spring of 2004, this report has reviewed the achievements of the Programme and sets out clear guidance for the continued management of the remediation projects.

Whereas the UNEP Programme focused on conflict-related environmental damage and risks to human health it was generally recognized that the majority of the country's environmental challenges are a consequence of inadequate environmental protection, management systems and practices during the past decades. In response to the overall framework, this assessment report has also identified chronic environmental problems at other industrial locations visited, and recommendations have been offered for addressing those problems, and similar problems elsewhere in the country. In addition, this assessment has looked beyond the question of industrial pollution to examine local capacities to manage the environment.

The responsible national and local authorities have recognized the immediate environmental problems and have taken important first steps in addressing them. Whilst UNEP's post-conflict activities ceased in the spring of 2004, UNEP will continue to work with the governments in the region and other international stakeholders, through the UNEP Regional Office for Europe.

I would like to thank the Serbia & Montenegro partners, national and local authorities, experts, site owners as well as the international partners and donors, for the successful and constructive cooperation during the UNEP Clean-Up Programme.

Klaus Töpfer
United Nations Under-Secretary General
Executive Director of the United Nations Environment Programme

FOREWORD

Five years ago diplomatic efforts failed to offer a way forward that would lead to peaceful resolution of the political conflict in the province of Kosovo and Metohija in southern Serbia. As consequence NATO started war against the former FR Yugoslavia, now the State Union of Serbia and Montenegro.

After almost three months of bombardment hostilities finally ceased on 10 June, 1999 but the consequences were horrific and long-lasting. In addition to the several thousands innocent civilians killed, the hundreds of thousands displaced from their devastated homes, and huge economic damage, the environment suffered to almost the same extent. Thousands of tonnes of hazardous chemical substances were released into the environment from targeted chemical and petrochemical plants, oil refineries and other industrial facilities.

The domestic and international environmental communities were alerted and most experts took the view that the war had already inflicted damage that would have long-term consequences for the environment of FR Yugoslavia and its neighboring countries. On the other hand NATO argued that its use of sophisticated weapons against carefully selected targets would minimize environmental and other so called “collateral” damages.

Based on the conclusions of the UN Inter-agency Humanitarian Assessment Mission that visited FRY during the war, from 16 – 27 May 1999, Executive Director of UNEP (at that time also Acting Director of UNCHS-Habitat) formed the UNEP/Habitat Balkan Task Force (BTF) which was given the assignment of evaluating the consequences of the war for the environment and human settlements in the Balkans, i.e. former FR Yugoslavia, Macedonia and Albania. The BTF visited the FRY between 17 July and 13 September 1999 and published its report at the end of October that year.

Due to the complexity of the situation, the BTF focused its efforts on exploring three key aspects: the most damaged industrial sites; the Danube River and some of its tributaries; and several legally protected areas to investigate damages to biodiversity.

As a result the BTF defined 27 urgent projects with the ultimate objective of eliminating environmental impacts and possible health consequences for the population. The donor community responded positively and provided the financial and technical assistance that enabled of the industrial “hot spot”, such as Novi Sad and Kragujevac, to be cleaned up to the extent that the label “ hot spot “ need no longer apply.

On the other hand, at Pancevo and Bor, which were also the subject of BTF activity steps were made in the right direction but much remains to be done before we actually solve the environmental problems at these and many other sites. These problems originate both from the war but also from inappropriate environmental practice in the past.

As the BTF operation comes to an end we would like to express our deep gratitude to UNEP and the donor community for everything they have done to help us identify and define ways of healing environmental wounds of the past and of the war. However we believe that both UNEP and the donor community will find ways and means to continue their support to the State Union of Serbia and Montenegro in its continuing efforts to secure healthy environment. We believe that this is in the mutual interests of us all, Serbia and Montenegro, our neighboring countries and the wider Europe, where we belong.

Dr Aleksandar Popovic
Minister of Science and Environmental Protection
Republic of Serbia

1. INTRODUCTION

With the government reforms that began in October 2000, Serbia & Montenegro has gradually entered a period of more stable political and economic development. The country has experienced real growth in its gross domestic product, low inflation, a stronger currency and renewed interest in foreign direct investment. The European Union (EU) integration process has been launched.

The country has also experienced important growth in its ability to manage the environment in recent years. Efforts are underway to harmonize Serbia & Montenegro's laws with EU environmental legislation. In Montenegro, the Ministry for Environmental Protection was formed in 1999 and integrated into the Ministry of Environmental Protection and Physical Planning (MEPPP) in 2001. In Serbia, the Ministry of Natural Resources and Environmental Protection was formed in 2002 and integrated into the Ministry for Science and Environmental Protection in early 2004.[1]

Serbia & Montenegro now faces the serious challenge of integrating environmental considerations with the country's pressing economic, social and political priorities. Principles of sustainability have not yet been broadly integrated into the country's policies or investments. Industries and surrounding communities remain deeply burdened with pollution, jeopardizing the benefits of economic modernization and recovery.

If Serbia & Montenegro is to continue on the path toward creating a strong, safe and healthful society, environmental protection must receive sustained attention and commitment. The country's transition presents a crucially important opportunity to halt the degradation of precious natural resources, implement cleaner production methods, reform environmental institutions, and establish sound and sustainable economic development.

From Conflict to Sustainable Development

In 1999 the United Nations Environment Programme (UNEP) reported on the environmental consequences of the Kosovo conflict and suggested immediate risk reduction measures at four environmental hotspots – Bor, Kragujevac, Novi Sad and Pancevo. UNEPs recommendations were received favorably by donor nations, which supported the creation of the UNEP Clean-up Programme in Serbia & Montenegro (the "Programme"). Since 2000, the Programme has worked to reduce the most urgent conflict-related environmental and health risk at these four sites.[2]

The Programme has taken measures to protect drinking water resources in Novi Sad, remediate ethylene dichloride (EDC) contamination and rehabilitate wastewater treatment capacities in Pancevo, and assess and remediate polychlorinated biphenyl (PCB) contamination in Kragujevac and Bor. Taking into account the important input by the Swiss Agency for Development and Cooperation (SDC) on five other remediation and monitoring projects, as well as the complementary activities by national and local authorities and assistance by Czech development partners, a total of 22 out of the 27 originally identified projects have been implemented, completely or in part.[3] These activities have resulted in improved conditions at all four sites to the degree that it is now appropriate to reconsider the "hot spot" designation at some of the sites.

The UNEP Clean-up Programme's limited, humanitarian assistance mandate is ending in April 2004. Overall responsibility for follow-up to the Programme is being formally transferred to Serbian environmental authorities. Environmental investments and technical operating responsibilities are being handed over to the site owners and relevant local partners.

In preparation for the handover, the environmental authorities in Serbia & Montenegro and UNEP agreed to conduct a joint environmental assessment. The aim of the joint assessment was to:

- review the environmental conditions at the four sites previously identified as "hot spots" in Serbia, including the risk reduction and remediation work undertaken by the Programme, as well as issues outside the direct scope of the Programme;

- review the environmental conditions at three other industrial sites elsewhere in Serbia & Montenegro; and
- assess municipal capacities to protect the environment.

By providing a detailed record of the status of the seven sites visited as well as local environmental capacities, this report will assist site owners and national and local authorities in their efforts to sustain and expand the risk reduction and remediation work undertaken by the Programme. In addition, the report gives clear recommendations to the country's environmental authorities, which have identified continuous remediation of contaminated sites as a major short-term priority.

Sites visited by assessment mission in November 2003

In November 2003, a team of national and UNEP experts conducted a field mission in the framework of the assessment. The mission consisted of site visits to 12 industrial facilities and/or contaminated sites in seven municipalities and meetings with a wide range of local stakeholders. In addition to the four sites previously identified as "hot spots", Sabac, Lazarevac and Niksic were included in the assessment in order to assist Serbia & Montenegro environmental authorities with identifying, assessing and prioritizing key environmental problems on the national and local levels.

At each site, the mission team made preliminary assessments of the industrial facilities and investigated municipal capacities to protect the environment. The site visits and local meetings were arranged in consultation with officials from the republic and local governments. The assessment methodology at each site included an opening meeting with the site owner; a presentation from the site owner about the industrial process; a walk around the site; and the completion of a standard questionnaire regarding emission and enforcement issues. The major departure from standard site assessment methodology was that site owners were advised in advance to identify areas of environmental concern that they wanted to highlight to the assessment team. National competent authorities provided sampling and analysis services.[4]

This report does not provide a comprehensive list of "hot spots" in Serbia & Montenegro, nor do the site assessments present comprehensive evaluations of the sites' environmental problems. Instead, the report contains independent reviews of the Programme's work and an assessment of the priorities for the future at the sites and municipalities visited.

This report's main findings, conclusions and recommendations are ultimately directed to the national authorities and industrial sites for follow-up. The international community however is expected to assist.

Chapter 2 provides a brief overview of key environmental institutions in Serbia & Montenegro and the country's general environmental framework, noting issues of particular relevance to this assessment. Chapter II also outlines the main environmental problems common to most industrial facilities and municipalities.

Chapter 3 sets forth the assessment's main findings and presents recommendations for each of the sites and municipalities investigated. In addition, Chapter III provides guidance to site owners and national and local stakeholders regarding the follow-up required to ensure sustainability of the UNEP clean-up projects. Chapter 3 also presents a broader set of specific recommendations for priority environmental issues at each of the industrial sites and municipalities visited.

The report's general conclusions and recommendations are summarized in Chapter 4 Annex 2 summarizes the key environmental issues identified at the industrial sites visited.

2. ENVIRONMENTAL PROTECTION IN SERBIA & MONTENEGRO

In December 2002, the Federal Republic of Yugoslavia adopted a constitutional charter that transformed the state to the "State Union of Serbia & Montenegro". Under the new constitutional charter, the State Union conducts international relations, including such matters as defence, trade and economic relations, human rights and minority rights. Responsibility for domestic matters, such as environmental issues, is delegated to the republic level and handled by ministries in the Republic of Serbia and the Republic of Montenegro, respectively.

The country's environmental situation is generally comparable to that of other countries in Central and Eastern Europe. During the 1990's, however, the country experienced sanctions and conflict. Investments in environmental protection and cleaner technologies suffered, and the degradation of environmental and natural resources intensified.

In more recent years, support for environmental protection has gained momentum, as evidenced by the creation of the republican environmental ministries and improvements in overall environmental protection capacities and legislation.

2.1 Main Institutions and Legal Framework

The main institutions responsible for environmental protection at the republican level are the Serbian Ministry for Science and Environmental Protection and the Montenegrin Ministry of Environmental Protection and Physical Planning (MEPPP). In July 2002, the two ministries agreed to cooperate on environmental protection and to establish a body to coordinate environmental activities requiring a unified state response.

The **Serbian Ministry for Science and Environmental Protection** is responsible for policy controlling noise, air, vibration, hazardous and toxic substances as well as nature protection. These policies are administered by the Ministry's Directorate for Environmental Protection. The environment ministry has in recent months grown fast and rapidly expanded its capacity to protect the environment. The republic's environmental programme for 2004 has listed the control of solid and hazardous waste pollution among its highest priorities. Follow-up to the UNEP Clean-Up Programme, as well as remediation of other hot spots, is also designated as a high priority requiring immediate action. Other top priorities include strengthening environmental institutions, enhancing environmental monitoring and damage control capacities, and protecting national parks and other protected areas.

In addition to the Ministry, a number of other Serbian institutions monitor and protect parts of the environment. For example, the Ministry of Agriculture, Forestry and Water Management is responsible for the protection of soil, water resources and forests.[5] The Institute for Nature Protection is responsible for protecting natural parks and wild fauna and flora. The Institute of Public Health is responsible for monitoring air, noise, water and groundwater quality in urban areas. The Republic Hydrometeorological Institute also monitors air and water.

In 1991, the Republic of Serbia adopted the Law on Environmental Protection and a series of related regulations. The Serbian Parliament is currently reviewing a proposed new environmental framework law. Once adopted, the new law will provide a legal and institutional system for environmental protection that is consistent, modern and harmonized with the European Union's framework. The recent establishment of the Environmental Protection Agency is expected to lead to more systematic monitoring, enhanced environmental information, and stricter inspections and enforcement.

Serbia has neither an integrated **environmental permit system** nor media-specific permits, except for a water resource permit. **Environmental impact assessments** (EIA) are performed at two stages. A preliminary

EIA is required to meet preliminary design and urban planning requirements, whereas a detailed EIA is an integral part of the final design documentation required for construction permits. The Ministry for Science and Environmental Protection reviews and approves the EIA before a construction permit is issued. Regulations on the environmental impact assessment of facilities were introduced in 1992. Facilities constructed prior to 1992, therefore, have not been required to conduct EIAs.

The current EIA system has notable shortcomings. Activities are subject to mandatory EIA procedures on a seemingly discretionary basis—with no clear cost or size thresholds, no distinction based on type of enterprise, and without consideration of the magnitude or scale of potential impact. The system's inadequacy is compounded by the fact that relevant environmental authorities lack the funds and staff resources to screen projects, review EIAs, and stipulate and enforce conditions and mitigation plans effectively. Local authorities often issue permits despite missing or incomplete EIAs. The pending framework environmental law would provide for EIA and strategic environmental assessments consistent with EU norms.

Environmental inspections in Serbia are carried out at the republican and municipal levels and, in Vojvodina, on the provincial level. The republican inspectors are authorised to enforce environmental protection regulations. The inspectorate has six departments—in Belgrade, Novi Sad, Sabac, Kragujevac, Uzice, and Nis—though several inspectors work in satellite offices, particularly in major industrial centres. Due to the fragmentation of inspection competences on the republic level, the environmental inspectors do not have authority to inspect soil and water, and little or no cooperation exists with other inspection services (i.e., sanitary inspectorate, building inspectorate, etc.).

The constitutions of the Serbian and Montenegrin republics provide for the right to a "healthy environment and timely information on the state of the environment". The two republics' current framework environmental laws, however, do not explicitly provide for the right to a healthy environment, but they do establish the right of **access to information** on the environment. **Public participation** is also not explicitly granted in the Serbian Law on Environmental Protection or in the regulations on environmental impact assessment. By contrast, the Montenegrin Law on Environment and the republic's Regulation on Impact Assessment each contain several provisions relevant to public participation in the decision-making process. Serbia & Montenegro is not a signatory to the Aarhus Convention on Access to Information, Public Participation and Access to Justice in Environmental Matters, which ensures these basic rights.

Vojvodina autonomous province, in which Pancevo and Novi Sad are located, has the legal authority to adopt environmental protection programmes through its own bodies and in accordance with state environmental legislation, and to establish public enterprises and an institute for nature protection. The province may also consent to environmental impact assessments for construction permits and implement environmental programmes requiring regular monitoring and inspections.

In Montenegro, the **Ministry of Environmental Protection and Physical Planning** implements the republic's framework environmental law and administers an environmental protection system that includes protecting and conserving nature and natural resources, imposing environmental conditions for construction works of public concern, protecting air, regulating the production, trade and disposal of hazardous substances, conducting inspections and enforcement activities, and introducing international ISO 14000 series performance standards. The Ministry's small Department for Environmental Protection consists of two divisions: one for Environmental Protection, which includes the ecological inspectors, and one for Environmental Policy, Economics and Information Systems. The MEPPP also supervises the Institute for the Protection of Nature, the Hydrometeorological Institute, the National Parks of Montenegro and the Centre for Eco-toxicological Research. The Centre for Eco-Toxicological Research monitors air, water, soil and radioactivity while the Institute for Nature Protection monitors biodiversity.[6]

Three other ministries have additional environmental competences: the Ministry of Agriculture, Forestry and Water Resources (water and soil protection, water resources management), the Ministry of Industry, Energy

and Mining (mineral resources exploitation and power supply) and the Ministry of Health (drinking water quality, environmental health). Formalized inter-ministerial bodies charged with coordination of policies and activities do little to alleviate this rather complicated institutional setup. On the other hand, the modest size of Montenegro's central administration compensates to a degree by enabling informal cooperation. At the parliamentary level, there is no special committee for environment.

In 1996, Montenegro adopted its **Law on Environment,** which establishes such important environmental protection principles as polluter/user pays, environmental impact assessment, and data transparency. Few by-laws, however, have been developed to implement these principles. In 1991, the Parliament in Montenegro declared Montenegro an 'ecological state'. In September 2002, at the World Summit for Sustainable Development in Johannesburg, the Montenegrin government relaunched its Sustainable/Ecological State Strategy. The Strategy outlines goals for Montenegro as an ecological state, including for sectors such as agriculture, culture, health, biodiversity, economic and social/human development.

Montenegro's Law on Environment requires **EIAs** for projects that may have adverse impacts on the environment. The republic's EIA regulations define general categories of activities that are covered with few specifications regarding size, impact or type of enterprise. On the basis of an approved EIA, the Ministry issues an **environmental permit** that specifies any required pollution prevention and mitigation measures. An environmental permit is necessary for performance of certain works or activities.

The Ministry's **ecological inspection unit** oversees compliance and enforces the republic's environmental law and regulations. Due to the complex division of environmental protection responsibilities among ministries, however, the environmental inspectorate's enforcement authority is rather limited. In addition to the republican environmental inspectors, there are also republican inspectors for mining, forestry, energy and water.

2.2 Environmental Management of Industrial Facilities

Serbia & Montenegro's industrial facilities today face the dual challenge of revitalizing themselves while addressing historical pollution problems. Within the country's industrial sector there is an urgency to prevent further environmental degradation and to initiate new environmental and industrial management practices. The implementation of, e.g., cleaner production methods, would improve industrial competitiveness, especially among small and medium-sized enterprises, while strengthening their ability to adhere to international environmental standards and trade requirements and to attract international investment.

Many of today's industrial pollution problems can be traced to management decisions. The country's former centrally planned economy far too often put a high premium on industrialization without taking adequate environmental safeguards. The frequent integration of product chains also meant that large industrial estates were created to enable a number of factories to share resources – e.g., land, utilities, treatment plants, storage space, etc. Environmental management responsibilities, however, were not clearly allocated or implemented, frequently creating large-scale pollution problems. In addition, for political and strategic reasons, many industries were located in areas with access to labour, and issues such as supply distances, the availability of water supplies and prevailing wind directions were ignored. On a plant level, managerial decisions often directed investments toward priorities other than environment.

Most environmental pressure in Serbia & Montenegro comes from industries located in urban areas, which pose immediate environmental and health risks to local populations.[7] Mining activities, fossil fuel-fired thermal power plants and industry have historically produced enormous amounts of air and soil pollution. Paradoxically, and despite poor abatement technology, declining industrial activity has lowered the quantity of air emissions.

Improper management and disposal of waste and wastewater, particularly hazardous waste, is one of the main environmental problems facing Serbia & Montenegro's industrial sector. In 2000, Montenegro's

MEPPP took a step in the right direction by adopting a Rulebook on Criteria for Selection of Locations, Method and Procedure for Storage of Hazardous Matters. The Rulebook obligates hazardous waste producers to collect, label, record, temporarily store and inform the Ministry about quantities and types of hazardous waste. The lack of national waste management infrastructure, however, has forced industries to store hazardous waste on site indefinitely, posing unacceptable threats to public health and the environment. More efficient and environmentally friendly production practices would help to alleviate this problem by reducing waste volumes.

In general, industrial facilities employ poor health and safety practices, and there is low awareness of how these practices may be contributing to overall environmental degradation. Similarly, emergency response procedures and capacities have not been well developed, creating the potential for substantial environmental damage in the event of accidents. Serbian environmental authorities have identified the preparation of accident response capacities as an important priority for 2004.

The country's industries are generally aware of these issues and have developed environmental expertise. Nevertheless, industry is not yet addressing a number of issues that it could rather easily resolve with existing resources—e.g., signage on hazardous waste, basic housekeeping at waste dumping area. Industry's considerable environmental challenges have only been worsened by an absence of political will to invest in the environmental externalities associated with industrial development. This, in turn, has resulted in a lack of available resources for addressing serious industrial pollution problems.

Serbia & Montenegro is blessed with abundant natural resources, including fertile soils, a mild climate, prime forests, agricultural land untainted by fertilisers and chemicals and easy access to one of Europe's main arterial highways, the Danube River. Although accession to the EU will present difficult challenges for the country, Serbia & Montenegro's important strategic position, and excellent human and natural resources provide a strong foundation for developing the country's embryonic environmental remediation and management industries.

2.3 Environmental Protection at the Municipal Level

Environmental protection is principally under the jurisdiction of the two republics. Local governments cannot, at present, adopt their own laws or regulations. Instead, they are responsible for enforcing state environmental legislation and for providing services such as water supply, sewerage, sanitation, and the collection and disposal of municipal solid waste.

The republics of Serbia & Montenegro are in the process of enacting laws on local self-governance and implementing administrative reforms that will decentralize competences and financial resources. The transfer of responsibilities to the local level will shed light on both institutional weaknesses and opportunities for improving local capacities for environmental management.

An increasing number of Serbian communities have created environmental secretariats or departments that are working to address local concerns and to regulate local activities in accordance with republic legislation. The secretariats have limited responsibility for environmental issues, but do regulate air and noise pollution, urban planning and construction permits for small facilities. They do not have competences for EIAs, which is a ministerial responsibility. In some cases, municipal waste management falls within the competences of the environmental secretariats. In others, it is managed by a separate municipal enterprise. Specially authorized municipal organizations monitor settlements in cooperation with the government-adopted Air Quality Control Programme. In cities with no environmental secretariat, republican environmental inspectors carry out the tasks that would otherwise be performed by a secretariat. In Montenegro, only larger municipalities have designated environmental staff and environmental inspectors. Cooperation between the MEPPP and municipalities is not yet well developed and is mainly informal in nature.

Municipal **inspectors** have fairly limited authority. They control polluters for whom the municipality issues licenses in the areas of air and noise protection. Reporting to the courts is done by any of the inspectors. In general, collaboration with courts, though potentially a powerful instrument, is underdeveloped. Court proceedings are slow and fines, in the end, are usually small.

A very significant and positive development on the municipal level in Serbia is the widespread creation of **Local Environmental Action Plans** (LEAPs). The LEAP process, which has evolved in over ten municipalities, has enabled a broad spectrum of local stakeholders to identify local environmental priorities and associated fundable projects. With the exception of Kotor municipality, LEAPs have not yet developed in Montenegro.

In Serbia & Montenegro, the major **municipal environmental problems** are in the areas of air quality, municipal and industrial waste, treatment and storage of hazardous waste, and wastewater treatment.

Despite Serbia & Montenegro's relatively low level of industrial activity, the degree of **air pollution** remains quite high. Air quality is being degraded by outdated industries, inefficient home heating systems, and aged motor vehicles using low quality fuel. Sulphur dioxide and particulate matter levels in industrial and urban areas often exceed permitted concentrations, which contributes to higher incidences of respiratory illness, diseases of the circulatory system and premature mortality. In general, the capacities and resources of most municipalities to monitor air pollution is limited, and accurate data on air quality is often not readily available to the local population.

Municipal waste collection and disposal is the responsibility of local public utilities. Most controlled landfills, however, do not meet sanitary standards, and separation or treatment does not occur. In rural areas, waste collection is practically non-existent. Instead, waste is dumped and frequently burned at illegal sites that are often along roads or riverbanks and pose sanitary risks.

Hazardous waste disposal practices in Serbia & Montenegro are a long way from meeting environmental management standards. There are at present no secured hazardous waste storage or disposal facilities in the country. As a result, although the state is responsible for hazardous waste, the risks and burdens of improper hazardous waste disposal are experienced locally. Many enterprises dump hazardous waste in uncontrolled municipal landfills. Others store it improperly on company grounds.

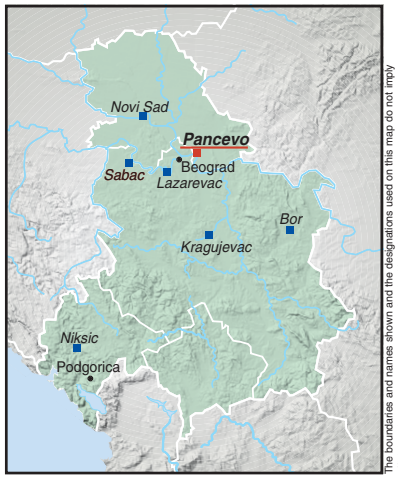
Approximately 85% of the country's population has **drinking water** delivered directly to their homes. A number of municipal water supplies, however, lack the revenues to maintain and improve their water supply networks. Water conservation practices have, for the most part, not been implemented.

Access to **sanitation services** in Serbia & Montenegro has increased during the past several years. Approximately 90% of homes are now connected to sewers and septic tanks. An estimated 85% of Serbia's wastewater, however, is untreated, resulting in significant groundwater and surface water pollution. The republic has 37 central wastewater treatment facilities: 30 provide secondary treatment, and the remaining seven provide primary treatment. Most of these facilities, however, are old and function poorly. In Montenegro, 60% of the republic's water users are connected to sewage systems, and only the capital, Podgorica, has a functioning wastewater treatment facility. Most often, wastewater is simply discharged into rivers and the sea.[8]

3. PRINCIPAL FINDINGS AND CONCLUSIONS

3.1 Pancevo

The municipality of Pancevo, in Vojvodina Province, has close to 130,000 inhabitants: 86,000 live in the city, the remainder in outlying settlements and villages. The city covers area of approximately 760 sq. km. on the banks of the Tamish River, four kilometers from the Danube River and 20 kilometers northeast of Belgrade. A major industrial complex, including a petrochemical plant, an oil refinery and a fertilizer plant, lies on thecity´s southern edge of the city.



3.1.1 Site Assessments

Pancevo Petrochemical Plant (HIP Petrohemija)

Key Environmental Issues

- Wastewater Treatment Plant (WWTP) receives effluent from number of units, including the refinery; and inadequate control over input (quantity, concentration) is causing frequent process failures and contamination of receiving water
- Unlined sludge lagoon threatens soil and groundwater
- Groundwater and soil contamination by chlorinated solvents
- Improper storage and disposal of waste (including mercury sludge, chemicals, asbestos-containing materials, PCB-containing transformers and capacitors)
- Substantial air emission exceedances

Site description

The HIP Petrohemija complex occupies 328 hectares in the industrial zones of Pancevo and Elemir. The complex comprises eight facilities, including an ethylene plant; high and low density polyethylene plants, chloro-alkali electrolysis plant; vinyl chloride monomer (VCM) plant; a polyvinyl chloride (PVC) plant; a utility plant; and a wastewater treatment plant. The complex annually produced approximately one million tonnes of petrochemicals, including basic chemical and polymer products such as polyethylene gas and water pipes.

Although the petrochemical industries in general continue to be profitable, HIP Petrohemija lost its markets in the 1990's when the country experienced international sanctions and extended conflict. Since the 1999 conflict, the complex's VCM and PVC plants have not been operating, and the chloro-alkali electrolysis plant operates at less than 10% of its designed capacity. When new markets are found, the complex's cash flow and capital situation should improve, making it easier for the industry to undertake proper management of its ongoing environmental problems. The privatization processes in Serbia & Montenegro may provide HIP Petrohemija with the opportunity to recover and attract required re-investments.

UNEP Clean-Up Programme[9]

HIP Petrohemija was heavily targeted by NATO during the Kosovo conflict, with several aerial strikes hitting the complex between April and June 1999. The main environmental concerns identified in post-conflict assessments of the complex were serious spills of ethylene dichloride (EDC) and mercury. The spills contaminated soil, groundwater and the complex's wastewater canal, which leads to the Danube. The wastewater treatment plant, though not directly hit, was also damaged, causing untreated wastewater from the refinery and the petrochemical plant to flow into the canal. In addition, large quantities of different hazardous chemicals were discharged into a sludge lagoon (near the wastewater treatment plant), which lacks proper basal lining, posing a severe risk of soil and groundwater contamination.[10]

Remediation of Ethylene Dichloride Pollution

Project Background: NATO bombing in April 1999 damaged tanks holding EDC. According to information provided by the site owner, approximately 2,100 tonnes of EDC was released, an estimated 50% of which is believed to have infiltrated the soil. The HIP Petrohemija site sits on five metres of unconfined sand backfill (shallow aquifer), which is itself on top of 2-3m of clay followed by alluvial sand with gravel sediments (deep aquifer). Site investigations performed in May 2000 revealed the presence of an EDC free-phase pool in the backfilled sand at the top of the clay layer where damaged EDC storage tanks are located. EDC concentrations detected in groundwater samples collected from the shallow aquifer were as high as 5.6g/l[11]. By contrast, Dutch groundwater environmental quality objectives require remediation if EDC concentrations are above 400 mg/l, and Serbia's 1998 drinking water regulations require EDC levels to be below 3 mg/l. EDC has been classified by the International Agency for Research on Cancer as a probable human carcinogen.

Project Objectives: UNEP's project sought to decrease health risks for factory workers and protect groundwater resources and the Danube River by reducing EDC contamination in groundwater and soil. The initially defined clean-up target,[12] was more precisely specified by undertaking detailed site investigations and a preliminary human health and environmental risk assessment, which recommended that the remedial target for the EDC clean-up should be removal of the free-phase and reduction of the dissolved phase to 1g/l.[13]

Project Achievements: UNEP, in close cooperation with HIP Petrohemija and Czech partners launched the EDC remediation project in June 2001. During January-July 2002 the comprehensive subsurface characterization works and pilot tests (Pump & Treat and Steam Enhanced Extraction tests) were performed in order to select the best available technology for soil and groundwater remediation at HIP PetroHemija´s VCM plant. The contours of the free-phase pool and the dissolved-phase chlorinated hydrocarbon plume in the shallow aquifer were defined. It was determined that the VCM plant's treatement facilities could treat fluids containing chlorinated hydrocarbons that resulted from groundwater remediation. The project upgraded the capacity of these facilities from 3.5 m^3/h to 5.5 m^3/h by August 2002and to 8 m^3/hour by late November 2003. Project investigations and data evaluation resulted in preparation of a general design for clean up of the upper aquifer. Measurements taken in October 2003 indicated that approximately 637 tonnes of EDC was present in a free-phase pool formed in the shallow aquifer.[14] The interim, remedial system, which focused on the shallow aquifer, recovered over 400 tonnes of EDC by January 2004 (approximately 93 tons of free-phase EDC and 316 tons of pure EDC recovered by treatment of contaminated groundwater). To ensure continued risk reduction, the site owner will be operating an upgraded full-scale system, commissioned and transferred from the Programme to the site owner in April 2004. The site owner will make regular progress reports to the competent national authorities and provincial environmental authorities.

Project specific follow-up to: Remediation of Ethylene Dichloride Pollution

- The EDC remediation activities, including optimisation and close monitoring of the full-scale remediation system, should continue in order to achieve the clean-up targets for the shallow aquifer.
- Clean-up target levels should be reviewed to ensure that they are based on updated risk assessments. Follow-up remediation technologies should be evaluated and implemented for shallow and deep aquifers, if such measures are identified as necessary and feasible by the site owner and the national environmental authorities.
- During any redevelopment of the remediation area HIP Petrohemija must ensure that EDC clean-up activities continue and the remedial system is not damaged.

Rehabilitation of the WWTP

Project Background: The HIP Petrohemija's WWTP has separate units for pre-treatment, primary treatment, secondary treatment and sludge treatment. The plant was designed to process 1,000 m^3 per hour of wastewater, including wastewater streams from all of the petrochemical complex's production plants and the neighboring Pancevo Oil Refinery. The WWTP was not directly targeted during the 1999 NATO bombing. Damage to the VCM and chloro-alkali plants and the oil refinery, however, resulted in the discharge of approximately 170,000 m^3 of raw materials, products and firefighting water. This flow overloaded the WWTP's capacity, damaged the process equipment, clogged the units with contaminated sludge, and cracked or otherwise damaged concrete retaining structures.

Project Objective: Rehabilitate the treatment plant in order to protect the Danube River system and downstream water supplies.

Project Achievements: UNEP started the project in 2001 in cooperation with HIP Petrohemija. The project has completed replacement of process equipment, repair of the trickling filter and pH regulating facilities. Remaining works, i.e. rehabilitation of the activated sludge will be completed by June 2004. The WWTP's hydraulic and treatment capacity has been restored and significantly improved compared to pre-conflict levels. The pollutant loading into the Danube River and associated risks to downstream water supplies have been reduced. Following the project handover in April 2004, the site owner is to report regularly to the competent national authorities and provincial environmental authorities on the operation of the rehabilitated facilities.

Project specific follow-up to: Rehabilitation of the WWTP

- WWTP efficiency should be systematically monitored and cooperation with the refinery's pre-treatment units enhanced, e.g. through studies of wastewater characteristics and on-line communication
- Further improvements and upgrades of the WWTP and training of staff should be undertaken in order to approach EU standards and achieve best practices (including emergency response measures)

Related clean-up projects

As part of the overall assessment, the mission also took note of project components and/or clean-up projects implemented at the site by other stakeholders. Czech development partners provided input to the remediation of EDC pollution. The SDC took over several monitoring programmes in the Pancevo industrial area. Although these projects indicated high concentrations of contaminants in groundwater samples collected inside the factories, off-site samples generally did not reveal either an increase in contaminant concentrations over time or the presence of contaminants above the limit values for drinking water

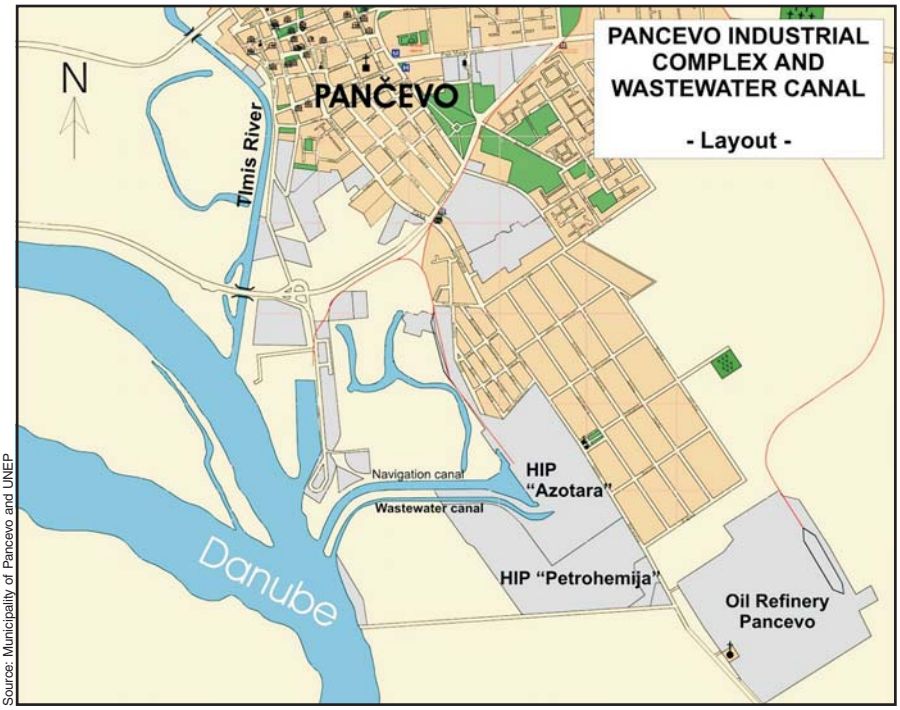
The SDC also removed soil that was highly contaminated with mercury and stored it temporarily in a safe disposal site (see Annex 3). In 2003, as a follow-up to urgent clean-up measures, SDC completed a preliminary risk assessment and feasibility study concerning further mercury-remediation options. The studies indicated that mercury contamination in the area of the electrolysis plant had already been a major concern prior to the Kosovo conflict. After the NATO air strikes, even more damage and contamination occurred.[15] Soil and groundwater contamination was determined to be limited to the shallow aquifer. Pilot tests indicated that the treatment of mercury-contaminated soil, though technically feasible, would not be justified given the site conditions, associated costs and amount of risk reduction anticipated.

Temporary hazardous waste disposal site: lined lagoon, containing mainly waste from HIP PetroHemija Electrolysis plant

Overall site assessment

The site assessment team visited HIP Petrohemija on 3 November 2003.

HIP Petrohemija's **WWTP** has a history of process upsets and detection mechanism failures. Oil and other pollutants have often spilled over to the plant's final biological treatment units. This is a priority concern requiring proper management attention beyond the scope of UNEP's conflict-related work (see above).



Source: Municipality of Pancevo and UNEP

Layout of Pancevo Industrial zone south of the town

HIP Petrohemija wastewater treatment plant (bio-filter, secondary clarifier - front), and unlined sludge lagoon (behind)

An **unlined sludge lagoon** in the vicinity of the WWTP (200m x 50m, depth approximately 5m) is filled with water and contains a substantial quantity of sludge (see Annex 3). Although this facility was originally built to collect sludge from the wastewater treatment process, it may have received solid waste from the complex's entire operations and thus could contain hazardous materials. Analytical results indicate high hydrocarbon concentrations in the sludge.[16] In its current condition, the lagoon poses a serious risk of contaminating soil and water, including the Danube River.

Outdoor storage of drums, Power plant, HIP Petrohemija

The petrochemical plant produces various forms of **solid waste**, including waste oil; **hazardous waste** containing lead, aluminum, and nickel; and approximately 20 transformers and 60 capacitors that contain **polychlorinated biphenyls (PCBs)**. The complex also has a properly built facility for temporary storage of **sludge containing mercury**. Improperly controlled drums containing mercury sludge and other chemicals, however, were noticed at a few locations during the site visit. Some of these materials are being stored indefinitely, because Serbia has no permanent hazardous waste disposal facility. Others are being stored pending use or reprocessing.

These various forms of waste all pose a serious threat to local soil and groundwater. The flow of groundwater under and around HIP Petrohemija causes the contaminants to migrate in a southerly direction from the factory premises toward an area where the land is predominantly used for agriculture. Although groundwater in the area south of HIP Petrohemija is not being used for drinking water supply, it is used for irrigation.

HIP Petrohemija's various boilers, process furnaces, pre-heaters and tanks release significant quantities of **air pollutants,** including sulphur dioxide, volatile organic compounds (VOCs), nitrogen oxides and particulate matter. Emissions monitoring conducted in 2003 found that particulate matter concentrations exceeded limit values in flue gases from the power plant's three boilers, which were fired by natural gas or heavy fuel oil, and from the ethylene plant's boilers.

Temporary storage of drums with mercury-contaminated sludge, Electrolysis plant, HIP PetroHemija

The power plant has no equipment for particulate matter removal. Carbon monoxide (CO) concentrations in flue gases from two of the boilers also exceeded the limit value.[17] In addition, there are fugitive emissions of various compounds from the complex's wastewater treatment plant and several tanks. The quantity of these emissions has not been calculated, but it may be considerable given the types of substances handled. There is also a very strong hydrocarbon odor around the wastewater treatment plant due to the wastewater quality and the location of the plant's aerators near the water's surface.

Site recommendations

Priority action

- Develop a comprehensive management system for the WWTP and pre-treatment units, including operating procedures for the various units, accidental spill prevention methods, emergency intervention protocols in the event of accidents, operator training and monitoring. These procedures are preconditions for the efficient operation of the WWTP and required environmental improvements.

- Continue the groundwater monitoring programmes in and around the Pancevo industrial complex and improve their coordination.

Medium-term action

- Design and construct chemical and waste storage facilities that include secondary containment and proper signage.

- Conduct a comprehensive Phase II environmental assessment[18] of the sludge lagoon adjacent to the wastewater treatment facility.

- Reduce SO_2 and particulate mater emissions from the boilers by, e.g., replacing heavy fuel oil with natural gas to the extent possible.

- Continue operating the EDC remediation system, and investigate the potential for in situ bioremediation of residual contamination.

- Develop a comprehensive solid waste management system that takes into account the solid waste that will be generated during the planned reconstruction/decommissioning of non-operational production units (e.g., the VCM and electrolysis plants).

Pancevo Oil Refinery (NIS-RNP)

Key Environmental Issues

- Accidental oil discharges into wastewater stream that leads to wastewater canal and Danube River
- Large-scale soil contamination from hydrocarbon spills and leaks
- Improper storage of chemicals and waste material
- Excess emissions to air, particularly of sulphur dioxide and particulate matter

Site description

NIS-RNP refinery produces gases; gasoline; jet fuel; aromatics; virgin naphtha (for HIP Petrohemija); kerosene; diesels; solvents; fuel oils; bitumen; liquid sulphur; and feedstock for the petrochemical industry. The vast majority (70-80%) of the refinery's crude oil is imported via a pipeline from Krk, Croatia and by barges traveling the Danube River from Romania and Hungary. The rest comes from oil fields located in the province of Vojvodina. The refinery has a maximum processing capacity of 4,820 million tonnes of crude oil per annum and a total storage capacity of 700,000 m^3 of crude oil and derivatives.

UNEP Clean-Up Programme[19]

Seven NATO aerial strikes hit the refinery between April and June 1999. As a result, approximately 80,000 tonnes of oil products and crude oil burned, releasing sulphur dioxide and other noxious gases into the atmosphere. In addition, an estimated 5,000 tonnes leaked into the soil and the sewer system, aggravating pre-existing soil and groundwater contamination at the refinery. The bombing also damaged the refinery's sewer system and wastewater pre-treatment unit. With the waste pre-treatment system incapacitated, untreated wastewater flowed directly into the wastewater canal, which empties into the Danube River.[20]

Construction of Concrete Basin for Oil Sludge

Project Background: The 1999 NATO bombing of NIS-RNP destroyed some of the refinery's production and storage facilities and caused large quantities of oil to spill into the ground, the sewer network, the refinery's wastewater pre-treatment facilities and, ultimately, the Danube River. To compound the problem, the spilled oil and oil products could not be removed and safely disposed of due to insufficient storage facilities.

Project Objective: To provide safe temporary storage capacity for oily wastes that were removed during rehabilitation of the sewer pipeline and the pre-treatment unit. A second objective was to provide temporary storage capacity for other oil waste from the refinery.

Project Achievements: UNEP, in close cooperation with NIS-RNP, completed the works in April 2003. Temporary storage capacity of 1.700 m^3 for the clean-up operations at the refinery was provided, allowing remediation of the pre-treatment facilities and sewage system.

Project specific follow-up to: Construction of Concrete Basin for Oil Sludge

- Monitor and control sludge storage basin's impermeability, the functionality of the equipment and the type of waste being disposed in it, i.e.sludge quality.
- Develop a permanent solution for treatment of the oil sludge's solid phase.

Cleaning and Repair of Sewer Pipelines and Oil Separators

Project Background: The NIS-RNP sewer system comprises three sewer networks (oily rain, rain and sanitary), wastewater pre-treatment facilities (oil separators) and pipelines that discharge pre-treated wastewater into the Danube River (rain water) and into the HIP Petrohemija WWTP (oil wastewater). During the 1999 conflict, large quantities of oil, debris and other materials clogged and partly damaged the sewer pipes, oil separators and discharge pipelines. Since the conflict, all of the refinery's wastewater has been discharged directly into the canal and the Danube River without final treatment of oily wastewater at HIP Petrohemija's integrated WWTP.

Project Objectives: Project's overall objective was to protect the Danube River system. The project's specific objectives were:

- to reestablish the NIS-RNP wastewater pretreatment facilities;
- to ensure that wastewater from the refinery meets the input specifications for final wastewater treatment at the HIP Petrohemija WWTP;
- to enable transport of pre-treated wastewater from NIS-RNP to HIP Petrohemija's WWTP; and
- to assess the refinery's sewer networks and outline a strategy for rehabilitation and priority repairs.

Project Achievements: UNEP, in cooperation with NIS-RNP, started rehabilitation activities in December 2001. The wastewater pre-treatment facilities have been repaired and upgraded, including repairs to the oil separators' structures, and new mechanical and instrumental equipment has been supplied. The repair of the wastewater pipeline between the refinery and the petrochemical plant, completed in April 2004, enables pre-treated wastewaters to be transported from the refinery to the WWTP before discharge to the wastewater canal. As part of its efforts to assist the refinery in defining its rehabilitation strategy and priority works, UNEP has also partially cleaned the refinery's sewer network and performed geodetic survey and design preparation. (As a consequence, NIS-RNP has already made some urgent repairs of the sewer system.) In the context of UNEP's overall handover of this project to the site owner in April 2004, UNEP delivered a study on technical solutions for rehabilitation of the refinery's sewerage system and for the proper management of the wastewater. Operating the pre-treatment facilities with improved efficiency and re-directing pre-treated oily wastewaters through the repaired pipeline to the WWTP for final treatment should significantly reduce pollution in the area and in the Danube River. Following the project handover in April 2004, the site owner is to report regularly to the competent national authorities and provincial environmental authorities, regarding the operation of the rehabilitated facilities.

Project specific follow-up to: Cleaning and Repair of Sewer Pipelines and Oil Separators

- Introduce an automatic control system for wastewater flows to/from the oil separators (including online oil-in-water monitors) so that process malfunctions at the refinery will not affect the HIP Petrohemija WWTP.
- Monitor pipeline integrity and ensure that all oily wastewater passing through the repaired pipeline is treated at the WWTP. The existing pipeline to the upstream end of the wastewater canal is to be removed after completion and trial of a new pipeline constructed by the refinery.[21]
- The plant's operators should be further trained to improve pre-treatment efficiency and to ensure the establishment of suitable emergency response measures, including the preparation of detailed internal procedures for wastewater management.
- Implement other priority activities recommended in the final design for rehabilitation of the NIS-RNP sewer system and the study for wastewater management, including:
  - Upgrading the facilities that redirect and temporarily store excess rainwater during heavy rains that would otherwise flow to the oil separators
  - Developing a comprehensive system for monitoring wastewater quality and quantity within the refinery.
  - Introducing on-line communications between the refinery's pre-treatment facilities and the HIP Petrohemija WWTP.
  - Improving the reliability and operation of facilities for pumping of pre-treated wastewater.

Overall site assessment

The site assessment team visited the refinery on 4 November 2003.

The **surface soil at the refinery is contaminated with hydrocarbons** in several locations. The presence of contaminated soil at the refinery decreases the equity value of the refinery and constrains redevelopment, especially since any new construction works would generate hazardous wastes with no suitable waste disposal route. In addition, the area's water table is very shallow, and there is evidence that free-phase oil and other petroleum hydrocarbons have contaminated the groundwater. The area's groundwater is not being used by NIS-RNP or as a local source of water supply, however, so the likelihood of an imminent threat to public health appears to be limited at present. Due to budget constraints, projects for addressing soil and groundwater contamination at the refinery, also identified in the UNEP Feasibility Study, were not implemented within the UNEP Clean-Up Programme (see Annex 3).

Upstream part of the Pancevo wastewater canal with wastewater outlets from HIP Azotara (right) and discharge of partly treated wastewater from the Oil Refinery (bottom, middle). In the back, HIP Azotara and the navigable canal

There have been **recurrent accidental spills of oily wastewater** from the refinery into the wastewater canal that is connected with the Danube River. Management is currently preparing plans to detect spills early and respond to them. UNEP's clean-up projects (discussed more fully above) have provided the refinery with tools to respond to spills and to prepare an integrated wastewater management strategy. National and local authorities have urged the refinery's management to implement a number of measures that are preconditions for remediation of the Pancevo wastewater canal. Rehabilitation and upgrading of the refinery's pre-treatment facilities would provide a buffer and limited treatment of such spills in the future.

Various forms of **solid waste** are stored on site, including oil sludge, sludge contaminated with heavy metals that is being temporarily stored in plastic drums, construction waste and general waste. A report from NIS-RNP indicates that there are 13 transformers at the facility that contain PCBs. Three additional transformers that are no longer in use also contain PCBs.

The refinery has two **waste oil sludge lagoons**. The older of the two has a capacity of 1,700 m^3 and contains waste oil sludge and sludge contaminated with mercury, lead and used catalysts.[22] Twenty open 205-litre oil drums containing oily sludge were stored adjacent to the old lagoon, and oil staining was noticeable. The new lagoon, a concrete basin, was constructed by the UNEP Clean-Up Programme and provides temporary storage capacity for sludge waste so that sewer lines can be cleaned and the newly reconstructed oil separators put in commission. The new basin has already been partly filled, and there is no control over the type of waste being dumped into it. A local company has been contracted to mix the basin's sludge with lime, potentially to be used as foundation material in road construction.

NIS Oil Refinery, Pancevo emission sources – stacks (behind), with HIP PetroHemija Electrolysis plant effluent lagoon (front)

The refinery has various sources of **air emissions**, including 18 main stacks, a power plant, large tanks, a loading/unloading facility as well as leaks from valves, pumps and other points. The most significant emissions are sulphur dioxide, volatile organic compounds (VOCs), nitrogen oxides and particulate matter. During process start-ups and abnormal situations the emission levels are markedly higher than normal. To reduce hydrocarbon emissions, new oil tanks have been equipped with floating roofs.

Emissions of SO_2 are of particular concern, having totalled a relatively high 5,400 tonnes from major refinery sources in 2002. The annual SO_2 emissions from major refinery sources are presented in Table 1.[23]

Table 1. SO_2 emissions in 2002 at the NIS-RNP oil refinery

	SO_2 emissions (t/a)
Atmospheric distillation I, S-100	650
Viscosity, S-200	550
Gasoline reforming, S-300	380
Atmospheric distillation II, S-2100	1,100
Vacuum distillation, S-2200	1,070
FCC (cracking), S-2300	110
Bitumen, S-0250	120
Power plant	1,400
Total	**5,380**

The refinery's 50-megawatt power plant is a major source of air pollution. The plant burns a combination of heavy fuel oil and natural gas. The fuel oil has a maximum sulphur content of 1.6%, whereas the natural gas has a lower, 0.5 - 0.6% sulphur content. To reduce sulphur dioxide emissions, the refinery decreases its use of fuel oil and increases its share of natural gas during unfavorable weather conditions.

The refinery occasionally receives public complaints about odors and dust pollution during specific meteorological conditions, i.e., when there is an inversion or no wind. The burning of solid fuels in residences and pollution from neighboring industries, however, make clear that the refinery is rarely the sole air pollution source.

The annual emissions of VOCs have not been calculated. Given the types of substances handled at the refinery, however, fugitive emissions of VOCs are likely to be considerable.

Overall, it seems that NIS-RNP has the capacity to identify, monitor and manage its worst environmental problems. As is true of many other industrial facilities in the country, however, a chronic shortage of capital has hindered investments in much-needed process and environmental management improvements.

Site Recommendations

Priority action

- Strengthen the facility's oil spill protection and detection systems with a view to preventing accidental spills of oil into the effluent stream. Install equipment (skimmers and absorbent booms) suitable for rapid response to /clean up of spilled oil, should any spills occur.

Medium-term action

- Undertake a Phase I site environmental assessment to identify the areas contaminated by hydrocarbons and chemicals with a view to initiating remediation activities.
- Groundwater monitoring activities within refinery should be continued.
- Design and construct chemical and waste storage facilities that include secondary containment and proper signage.
- To cost effectively reduce SO_2 and particulate matter emissions, the heavy fuel oil currently used in boilers should be replaced with natural gas to the extent possible.

Pancevo Fertilizer Factory (HIP-Azotara)

Key Environmental Issues

- Disposal of untreated wastewater into the wastewater canal
- Air pollution from nitrogen oxides and ammonia
- Inefficient use of abstracted water for cooling and firewater

Site description

The HIP-Azotara facilities were constructed in 1959 and grew to become Yugoslavia's leading producer of mineral fertilizers. At its peak, the factory produced between 1,200-1,400 tonnes per day of calcium ammonium nitrate and 300 tonnes per day of urea as well as large quantities of NPK (nitrogen-phosphorus-potassium) fertilizer, ammonia, ammonium nitrate, nitric acid and nitric solutions, compressed gases and de-mineralized water.

The site, which borders the HIP Petrohemija complex, occupies 127 hectares and includes five operational and three non-operational facilities. It is surrounded on three sides by residential areas. The plant is connected with the Danube River by a two-kilometer long navigable canal that enables the transport of raw materials and products. Process and cooling water is abstracted from the navigable canal by a pumping station. Drinking water is abstracted from two groundwater wells.

Wastewater from the factory is discharged at the beginning of 2-kilometer long wastewater canal connected to the Danube River. The wastewater canal also receives treated industrial wastewater from Pancevo Oil Refinery and HIP Petrohemija. The canal is artificial and besides industrial wastewater there is no other flow through it.

HIP-Azotara's natural gas-fuelled utility plant generates steam and hot water. The utility, however, is currently not operational due to the high price of gas. Instead, electricity is supplied from municipal mains. When it was operational, the plant reportedly received frequent pubic complaints about ammonia emissions, especially during southeasterly prevailing wind conditions.

During the Kosovo conflict in 1999, the plant was hit by bombing. In 2000, eleven months after the plant had shutdown, the ammonia plant was repaired and HIP-Azotara resumed production. The world fertilizer market has been depressed, however, and the plant halted fertilizer production in May 2003. At the time of the UNEP's 4 November 2003 site assessment visit the plant's activities were limited to the re-packaging of imported fertilizer and minor maintenance works. The only operational equipment were the fire-fighting pumps and the air compressors. It was subsequently reported, however, that HIP-Azotara again resumed fertilizer production in December 2003.

UNEP Clean-Up Programme[24]

In April 1999, during the Kosovo conflict, the plant was struck by a NATO aerial attack. The NPK plant and the fuel oil tank farm were destroyed, and the ammonia plant was damaged. Large quantities of hazardous substances from the entire industrial complex reached the wastewater canal and poured into the Danube River. To avoid potential health risks for the workers and the surrounding population, the site managers released approximately 250 tonnes of ammonia into the wastewater canal and the Danube. Groundwater in the area and wells used for drinking water and agricultural purposes may have been affected by the spills.[25]

Wastewater Canal Remediation Phase I: Preparation of Technical Documentation and Design

Project Background: Prior to the Kosovo conflict, the wastewater canal received untreated wastewaters from HIP-Azotara containing significant amounts of ammonium and fine calcium carbonate sediment, treated effluent from Petrohemija's WWTP and pre-treated rain wastewater from NIS-RNP. Following the April 1999 bombing at Pancevo, however, a large volume of contaminated industrial wastewaters containing raw materials, products and fire fighting water were spilled into the canal. UNEP investigations in 1999 and 2000 confirmed that high concentrations of pollution originating from the industrial wastewaters had contaminated the canal. In particular, high concentrations of EDC were present in the canal's water and the canal's sediment was impacted with EDC, mineral oils and mercury.[26] EDC concentrations in the sediment's top layer varied from 130 mg/kg to 300,000 mg/kg, indicating the presence of free phase EDC in some of the canal's bottom locations. Significant concentrations of mercury (from 1.4 mg/kg to 40 mg/kg) and petroleum hydrocarbons (from 5,000 mg/kg to 32,000 mg/kg) were measured in the canal sediment. High concentrations of these pollutants were found in deeper layers of the sediment indicating chronic pollution of the canal.[27] A considerable amount of PVC dust was also later identified in the canal sediment. A precondition for effective remediation of the canal is reduction of untreated industrial wastewater discharges into the canal.

Project Objectives: UNEP's investigations indicated that there was an urgent need to prevent the discharge of dissolved and sediment-associated pollutants into the Danube River. The overall objective of the Project, therefore, was the protection of downstream drinking water resources and the Danube River system. The objective of Phase I of the project was the preparation of technical documentation and the design of an environmentally acceptable remediation strategy.

Project Achievements: UNEP, in close cooperation with the Serbian environmental authorities and local stakeholders, completed pre-design investigation work in 2001. The site's sediment was comprehensively characterized. Investigations confirmed that the canal contained 41,000 m^3 of sediment that included significant concentrations of mercury and mineral oils. Results also revealed a significant reduction in EDC concentration and that the free phase EDC was no longer present in the canal.[28] Further investigations in 2002-2003 revealed that EDC concentrations in the sediment had further reduced to almost negligible values. Mercury and mineral oil concentrations, however, remained high. An estimated 550 tonnes of mineral oils and 260 kg of mercury were determined to be present in the canal.[29] The pollutants are primarily bound to solid particles, though very small portions of pollutants can be dissolved and washed out. During 2003, preliminary EIAs and general designs were developed for two remedial options: (i) dredging the sediment and depositing it in a new landfill and (ii) dredging and dewatering the sediment and treating it with thermal desorption. A review of the preliminary EIA and general design for the thermal desorption option is to be completed by April 2004. Stakeholders in Pancevo and the national environmental authorities have expressed their commitment to technical preconditions for sustainable remediation measures, and a potential donor/co-donor has been identified for remediation of the canal.

Project specific follow-up to: Wastewater Canal Remediation Phase I: Preparation of Technical Documentation and Design

- Stakeholders should ensure fulfillment of the key project preconditions:
  - Development and implementation of an integral wastewater management strategy for Pancevo industrial complex.
  - Sufficient funding /co-funding resources to fulfill project requirements.
- The national environmental authorities should develop national soil/sediment remediation guidance and criteria. Hazardous waste of a similar nature, including contaminated soils and sludge from oil refineries, is being generated throughout Serbia & Montenegro. At present, the state has no capacity to treat or dispose of these wastes. Pancevo wastewater canal remediation should be viewed in this broader context and should serve as a stimulus for addressing the country's broader hazardous waste problem.
- Monitor water and sediment in the wastewater canal and the Danube River.

Overall site assessment

The plant's activities were limited at the time of the UNEP site assessment on 4 November 2004. In order to prepare for and avoid future pollution problems, the UNEP team assessed environmental issues that may arise during future periods of higher production.

When the facility is operating, it discharges **untreated wastewater** that combines cooling water with ammonium, nitrates, nitrites and suspended solids of calcium carbonate. During periods of regular production, 7-8 tonnes of ammonium nitrogen alone enters the canal each day. According to information from HIP-Azotara, recent studies indicate that improving the plant's wastewater management would require reconstructing the plant's sewerage system, introducing a closed cooling system in some production plants and establishing wastewater treatment plants. Implementation of these measures would cost an estimated 5 million Euros.[30] Compliance with EU standards, however, would require considerable reconstruction of production plants and introduction of cleaner technologies. According to information provided by HIP-Azotara, some reconstruction activities have already been started, e.g., construction of a new urea plant and preparation of designs for reconstruction of the calcium-ammonium-nitrate plant. These activities depend strongly upon economic factors and the possible privatization of the factory.

The wastewater canal and HIP Azotara, view upstream from the bridge at the middle of the canal

During regular production, HIP-Azotara's nitric acid plant, urea facility and boilers emit noxious **air pollutants**. The most significant emissions are nitrogen oxides from the nitric acid plant's exhaust gases. The urea factory emits particulate matter and ammonia, which has been the source of complaints from local residents. Monitoring results from May 2003 indicate the presence of ammonia concentrations in the range of 10-43 $\mu g/m^3$, well below the limit value of 100 $\mu g/m^3$.[31] The fertilizer plant, however, was probably not operating at its full capacity.

The HIP-Azotara complex generates various forms of **solid waste**, including hazardous waste from chemicals, which is being temporarily stored on site; scrap metal, and nickel and palladium catalyst waste, which is

being recycled; and waste oil, which is being recovered by an outside contractor. It was reported that the plant's transformers and capacitors have been replaced and that PCB-containing mixed oils are currently being stored in nineteen 205-liter drums onsite. The facility's general waste is deposited in the Pancevo landfill.

Historically, the complex's utility plant received crude oil fed from the main tank farm via an underground pipeline and storage tank. Following the Kosovo conflict, an SDC-supported project excavated and transported the oil-impacted soil from the area around the destroyed crude oil tank farm to a landfill. There is visual evidence, however, that **crude oil** remains in the soil surrounding the underground storage tank adjacent to the utility plant.

Both process and cooling water is abstracted from the Danube River by a pumping station with a maximum flow rate of 10m^3/second. However, no cooling or process water is re-circulated and, hence, a high electrical load is associated with this practice.

Site Recommendations

- Review the wastewater management within the factory with a view to segregating and treating streams by pollution level.
- Review the air pollution control measures for nitrogen oxide and ammonia and upgrade facilities as appropriate.
- Review the factory´s overall water management with a view to minimising the amount of freshwater abstracted for cooling and fire fighting.

3.1.2 Institutional Capacity to Protect the Environment

The Municipality of Pancevo has recently established a **Department of Environmental Protection** (DEP). The DEP has eight staff and consists of a project development and international cooperation section (2 staff), an environmental inspection unit (3 inspectors) and a department of communal services. Overall, the municipality's current environmental priorities are hazardous waste storage and disposal; wastewater collection and treatment; drinking water quality; air pollution, emergency risk planning; environmental education; and pollution from agriculture and industry.

With regards to implementation of the UNEP clean-up projects at Pancevo industrial complex, the site owners have generally shown a strong commitment to the projects and have been satisfied with the measures taken by UNEP. The local government expected that UNEP would be able to complete all of the projects identified in the original Feasibility Study and has expressed frustration with the speed of implementation. UNEP's ability to implement projects, however, has been dependent on the availability of donor funding. Moreover, UNEP's work at the complex has illuminated the challenges yet to be faced by national and local stakeholders as they assume responsibility for remediation of a site that is burdened with historical environmental problems caused by decades of insufficient investment and inadequate attention to environmental management needs.

Inspections are taking place at the republican, provincial and municipal levels. Municipal inspections are conducted at facilities that have been issued municipal permits and are principally limited to air and noise. Violations are reported to the republican inspectorate. Construction permits are issued at the republican and provincial levels (Vojvodina) for larger enterprises and at the municipal level for small and medium size enterprises. Municipalities, however, can object to the issuance of construction permits for large facilities on the basis of the municipality's urban plan. The new law on local self-government should transfer additional responsibilities to the municipal level.

The municipality prepared State of the Environment reports for the years 2000, 2002 as well as 2003, and in 2003 Pancevo launched a **LEAP process**. Following the identification of key stakeholders (including representatives of municipalities, villages, local territorial administration, public companies, regional institutions, industries, NGOs, and citizens), two specific bodies were established—a Working Group and a Coordination Body. The stakeholders identified priority projects in seven areas: air, wastewater, drinking water, communal waste, hazardous waste, green areas/parks, and access to environmental information. The LEAP document was approved in December 2003 and is expected to serve as basis for priority action.[32] The European Agency for Reconstruction has supported the LEAP process and has committed funds for project implementation. Additional funds will be sought from the state, the Ministry of Agriculture and Water Management, the province of Vojvodina, commercial sources and other international organizations.

Pancevo has a small but energetic **NGO community**. The organizations are working to build public awareness through the media, events and environmental education. Their priority environmental concerns are air pollution, waste (including Pancevo wastewater canal), insufficient environmental information and building broad support for LEAP projects. In general, the NGOs have developed working relationships with local authorities, and a number are members of the LEAP process. Some groups are also cooperating with the municipality on specific projects.

The municipality controls all **wastewater discharges** into the public sewer system. Industries that discharge directly into natural waters fall under the jurisdiction of the republic's Water Management Inspectorate and are obliged to measure the quality and quantity of their discharges. The state has prepared a cadastre of water polluters.

Environmental monitoring is not well established in Pancevo. Recently, however, steps have been taken to upgrade the system and improve coordination of existing monitoring activities. The local authority has

indicated interest in following up on a monitoring programme that was funded by the SDC and implemented during 2001-2003 in the area outside Pancevo industrial complex. The programme included sampling of soil and sediments, living organisms, vegetation, and urine.[33] With the support of Italian partners, Pancevo has also recently obtained air monitoring equipment and training. Three stations will continuously measure the average values and hourly concentrations of sulphur dioxide. In addition, three meteorological stations have recently been installed on the roofs of nearby industrial plants, enabling real time communication and the possibility of reducing emissions during production.

The republic's **Hydrometeorological Institute** conducts basic water quantity and quality monitoring throughout Serbia, while the Public Health Institute-Pancevo monitors and reports on local drinking water supplies. The municipal water and sewer enterprise has implemented its own groundwater-monitoring programme, initiated with the support of the city of Amsterdam, Netherlands.

The **Public Health Institute – Pancevo** monitors air quality, drinking water quality, recreational waters and food. The Institute makes daily, monthly and annual reports and bulletins available to the public, the municipality, the Ministry of Science and Environmental Protection, the Ministry of Health, and other interested bodies. It also submits to the municipality daily air quality measurements that are taken at two stationary locations. If daily monitoring results reveal that parameters are exceeding permitted levels, the municipal DEP sends the data to local radio and television stations for broadcast, to the factories presumed responsible for the emissions and to the responsible inspectorates. In addition, monthly reports are routinely submitted to the local newspaper "NIP Pancevac" and other interested organizations on request.

In 1998, the Public Health Institute studied respiratory diseases and morbidity rates among schoolchildren in Pancevo and in rural areas. The study found higher morbidity rates and lower respiratory capacity among children in the city. In 2003, a new project on respiratory diseases among children was initiated in cooperation with the municipality.

The **Tamis Institute** monitors river water, soil, and agricultural crop seeds. The Institute has a certified laboratory but, as is true of most other stakeholders with monitoring responsibilities, lacks proper equipment and resources. Soil quality in the region is generally considered excellent, perhaps owing to the fact that farmers have used almost no pesticides and/or fertilizers during recent decades. With almost 60% of the population in the region earning a living from agriculture, and taking into account the economic difficulties of the industrial sector, organic farming may offer promising economic development potential for the region.

A public enterprise performs municipal waste collection and disposal. Medical waste is sterilized and disposed at the municipal landfill; no treatment or incineration occurs. Pancevo is currently constructing a new **regional sanitary landfill** according to EU guidelines. The provincial government and the municipality are funding the project. The regional landfill should be operational during first half of 2004, after which ten local landfills will be phased out. A commission has also been formed to find a proper solution for medical waste disposal.

The public service for **water supply** and sewage, Pancevo Waterworks, covers Pancevo and four neighbouring settlements. Local drinking water comes from underground sources upstream of the city and the industrial complex. Regular water quality analyses indicate that the city's drinking water is generally within applicable standards. The raw water is aerated, filtered and chlorinated. The existing filtering capacity, however, is not sufficient.

The city's **water supply network** is in poor condition and loses approximately 30% of its supply. Water consumption averages 270 litres/day/person in apartment buildings and 170 litres/day/person in privately owned houses, most of which have meters. Although drinking water and sewage costs an average of one Euro/month/person, only 60-70% of private users pay their bills. No efforts have been made to limit consumption through demand-side solutions.

Only one-third of Pancevo's customers are connected to the sewer system. The municipality is planning to construct a **wastewater** plant, but funds are not available to cover the costs. Although industries connected to the public sewer network are obliged to pre-treat their wastewater, only 8-9 % of all industrial wastewater is, in fact, pre-treated. The municipality charges industry 0.20-0.60 Euros for each cubic meter of wastewater discharged into the system. Reportedly, only 25% of industrial users pay their bills.

Recommendations

- Priority activities identified in the Pancevo LEAP process should be implemented, and supported by the national authorities and international partners. In particular, major environmental infrastructure initiatives are required: construction of a wastewater treatment plant; upgrade and maintenance of the city's water supply and sewer network; and completion of the regional sanitary landfill. Demand-side solutions should also be carefully investigated to find the most cost-efficient approach.

- With monitoring responsibilities distributed among a wide range of stakeholders it is important that municipal and relevant national authorities improve coordination to ensure the timely flow of information and data. Systematic and transparent information sharing is needed among monitoring stakeholders to ensure that all relevant information is available to decision makers and the public.

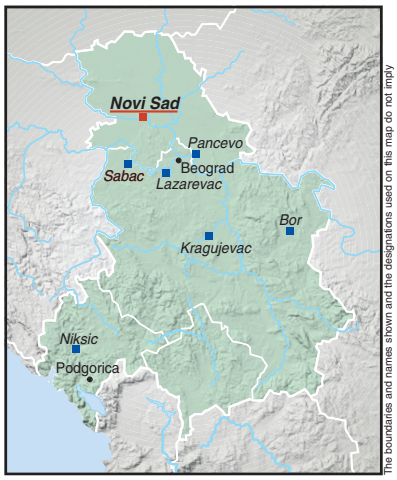
- To complement and maximize the value of on-going monitoring activities (e.g., air, water and soil quality), epidemiological studies should be conducted to determine incidences of respiratory illnesses, cancers and other illness possibly linked to pollution exposures.

- Municipal inspectors currently have narrow competences and limited communication with their colleagues on the republican level. As such, their capacity to protect the local environment is not being fully exploited. Mandates should be clarified and extended, staff trained and equipment upgraded to improve the quantity and quality of environmental enforcement.

- The proper storage and disposal of hazardous and medical waste is a challenge being confronted across Serbia & Montenegro. Regional and national-level solutions based on waste prevention and cleaner production strategies should be urgently pursued, consistent with the country's National Waste Management Strategy.[34]

3.2 Novi Sad

Novi Sad is the capital of Vojvodina province. With a population of approximately 305,000, it is Serbia's second largest city, comprising two municipalities: Novi Sad and Petrovaradin. The city is located in the southern Pannonian valley and on the west bank of the Danube River. Novi Sad sits on an alluvial terrace approximately 80 meters above sea level at a point where the Danube is only 350 meters wide. A small navigable canal connects the city with the Danube-Tisza Canal.

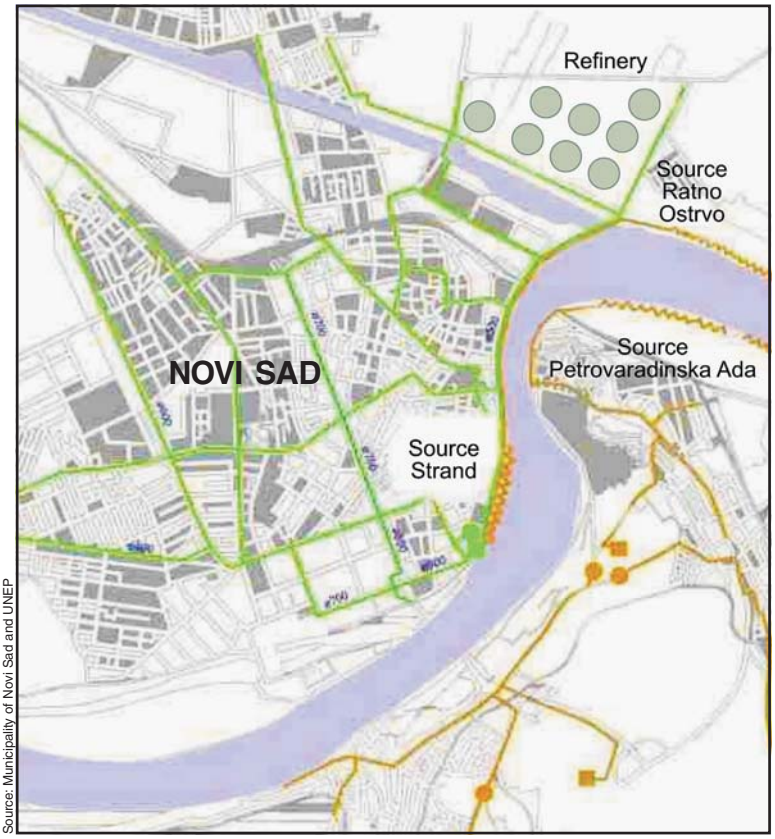


3.2.1 Site Assessment

Novi Sad Oil Refinery (NIS-RNS)

Key Environmental Issues

- Hydrocarbon contamination of soil and groundwater
- Damage to the wastewater collection systems
- Improper storage and disposal of oily sludge and chemicals



Source: Municipality of Novi Sad and UNEP

Outline map of Novi Sad showing location of refinery and groundwater sources for municipal water supply

Site description

NIS-RNS produces a number of products including gasoline (leaded and unleaded), jet fuel, kerosene, heating oil, diesel, hydraulic oil, liquid paraffin, motor oil, transmission oil, grease, bitumen, hydraulic brake fluid and anti-freezes. The refinery has a design capacity of three million tonnes of crude oil per annum and a storage capacity (for crude oil and products) of 670,000 m3. The utility plant's boilers raise steam and are fuelled by heating oil and/or natural gas.

The refinery is located on the bank of Danube-Tisza Canal, approximately 1.5 kilometers from Novi Sad's city centre. The refinery occupies an area of 156 hectares above gravely-sandy silt deposits that are up to eight meters thick. Groundwater is shallow, located just 1-2 meters below ground level, and flows towards the southeast.

UNEP Clean-Up Programme[35]

The Novi Sad oil refinery was the target of several aerial strikes during the 1999 Kosovo conflict. The primary environmental concern identified by post-conflict assessments was the potential risk to the drinking water wells downstream from the refinery. During the conflict several storage tanks and pipelines at refinery were damaged, and it is estimated that over 70,000 tonnes of crude oil and oil products burned or leaked into the wastewater collection system and the ground, causing contamination of soil and groundwater.[36]

Remediation of Free Phase Oil in the Groundwater Table

Project Background: The bombing of NIS-RNS during the Kosovo conflict caused large quantities of oil to spill to the ground. The refinery was constructed on back-filled sand and hence the spilled oil can easily reach the shallow (1-2 meters deep) groundwater table. The presence of free-phase oil poses a risk to drinking water quality in the Ratno Ostrvo catchment area and to the Danube environment generally. Visual inspection and analyses of groundwater samples in the south-western part of the oil refinery indicated the presence of free-phase oil in the groundwater table, with samples containing up to 22 mg/l of total petroleum hydrocarbons.[37] By comparison, under Dutch groundwater environmental quality objectives the target value for total petroleum hydrocarbons is 50 mg/l and the remedial intervention value is 600 mg/l.

Project Objective: Protect the drinking water sources in the Ratno Ostrvo area.

Project Achievements: UNEP, in close cooperation with Novi Sad refinery (and building on complementary studies by Czech partners), delineated areas within the refinery compound where free phase oil is present in the groundwater table. Following a review of remediation alternatives, UNEP conducted pilot studies of remediation techniques and implemented the selected remediation technique to begin risk reduction. By January 2004 approximately 4.5 tonnes of free phase oil had been recovered. In February 2004, the mobile abstraction/separation unit was handed over to NIS-RNS, which is responsible for the continued operation of the unit and for submission of regular progress reports to the national and provincial environmental authorities. Although the project has reached its objectives, it provides only a limited solution to the refinery's historic and more recent pollution problems.

Project specific follow-up to: Remediation of Free Phase Oil in the Groundwater Table

- Operate the mobile bioslurping unit, monitor oil recovery rates and optimize the remedial process by connecting the most productive wells to the mobile unit.
- Use the bioslurping unit as an emergency response tool for cleaning up leaks and oil spills. NIS-RNS should ensure the availability of trained staff and equipment, such as absorbent booms, access to vacuum tankers, temporary storage facility, etc., in order to facilitate integrated emergency responses to oil spills.
- Repair the damaged underground pipe network to prevent ongoing pollution.

Construction of a Hydraulic Barrier at the Eastern Border of Novi Sad Refinery

Project Background: In addition to the spillage of large quantities of oil caused by the 1999 conflict, the refinery has other historical and ongoing pollution sources. As such, the entire refinery area can be considered a potential source from which contamination could migrate. Because the Ratno Ostrvo drinking water wells are near the refinery, immediate measures for protecting the wells were seen as Novi Sad's highest priority.

Project Objectives: To protect Novi Sad's Ratno Ostrvo drinking water sources by preventing groundwater contamination originating at the refinery from reaching the drinking water wells.

Project Achievements: UNEP, in close cooperation with Novi Sad Waterworks, took the immediate preventive measure of constructing a hydraulic barrier between the refinery and the drinking water wells. The project commenced in summer 2001 and the hydraulic barrier was handed over to Novi Sad authorities in April 2002. Contamination migrating from the refinery towards the drinking water wells has not passed the line of the hydraulic barrier, indicating that the barrier was completed in time. Although the project has fully met its preventive objectives, additional measures are needed in the longer term to address contamination sources at the refinery.

Project specific follow-up to: Construction of a Hydraulic Barrier at the Eastern Border of Novi Sad Refinery

- Address contamination sources within refinery to prevent pollution releases.
- Perform regular maintenance and periodic testing on the hydraulic barrier.
- Refine/update the criteria for when to start up the barrier in response to groundwater monitoring results and new data/knowledge regarding site conditions. Consider including the wells in the hydraulic barrier in the monitoring programme as a "second line of alert".

Groundwater Monitoring Programme

Project Background: The Novi Sad water supply wells at Ratno Ostrvo are located close to the refinery. A comprehensive clean up of the refinery area is not anticipated while the refinery is still in operation. It is necessary to closely monitor the groundwater sources inside and outside the refinery area in order to provide early warning of contaminant migration in the region, in particular towards the water supply wells.

Project Objectives: To protect Novi Sad's Ratno Ostrvo drinking water sources by closely monitoring the groundwater resources in the refinery area.

Project Achievements: Since November 2000, UNEP, in close cooperation with Novi Sad Waterworks, NIS-RNS, the Institute of Chemistry as well as the SDC, has been monitoring groundwater quality in the area. The extent of groundwater pollution from spills at Novi Sad refinery has been determined. Groundwater samples collected between the source zone and the water wells have not identified a consistent trend of increasing contaminant concentrations. The velocity and preferential pathways of contaminant migration from the source zone have been modelled, with results confirming the long-term risk to the water wells. This data enables an early warning of pollutant migration from the refinery and provides the basis for determining when to start-up the hydraulic barrier operation. No immediate threat to the quality of groundwater abstracted from water supply wells in Ratno Ostrvo has been identified. Hand over of the monitoring programme to NIS-RNS and Novi Sad Waterworks took place in February 2004. Following the handover, the site owner and the Waterworks are to report monitoring results to the national and provincial environmental authorities regularly.

Project specific follow-up to: Groundwater Monitoring Programme

- Continue and optimise/update (scope, sampling frequency) the monitoring programme, based on data collected and using the available numerical groundwater flow model. Consider incorporating the hydraulic barrier wells into the monitoring network
- Strengthen the capacities of the refinery and the municipality to interpret data
- Institutionalise data sharing among the refinery, national environmental authorities, regional/local authorities and the public.

Repair of the Sewerage Collector outside the Novi Sad Refinery

Project Background: An approximately 2-kilometer long, buried concrete collector conveys wastewater from NIS-RNS, across the Ratno Ostrvo water well area, to the Danube. The collector and the wells are operated and maintained by Novi Sad Waterworks. The 1999 NATO bombing may have further damaged the collector, which was reportedly in bad condition prior to the conflict. Severe leakage from the damaged collector has been polluting groundwater and threatening nearby drinking water wells.

Project Objectives: To assess and repair the collector structure in order to prevent wastewater in the collector from leaking to the groundwater and polluting source waters.

Project Achievements: The project, implemented by UNEP in close cooperation with Novi Sad Waterworks, was completed in September 2003. The collector's cracked and leaking parts were sealed, preventing further pollution. In February 2004, the project was handed over to Novi Sad Waterworks and the Municipality of Novi Sad.

Project specific follow-up to: Repair of the Sewerage Collector outside the Novi Sad Refinery

- Continue monitoring groundwater quality (see above).
- Extend the collector to provide an outlet further downstream from the Ratno Ostrvo source area.[38]
- Review the need for repair and structural strengthening of the collector's upper structure/slab.
- Provide for final disposal and/or treatment of sludge removed from the collector.

Overall site assessment

The site assessment team visited the refinery on 5 November 2003. As part of the overall assessment the mission also took note of project components and/or clean-up projects implemented at the site by other stakeholders. For example, Czech development partners have provided input to more detailed investigations of soil and groundwater contamination within the refinery and have initiated pilot-remediation activities. In addition, SDC, as part of its activities in Novi Sad, implemented a groundwater monitoring programme outside the refinery.

Novi Sad's **water supply** comes from alluvial aquifers along the Danube River. The vast majority of the water (80-90%) originates in the river. The supply is mainly abstracted through wells with horizontal collectors located at the Ratno Ostrvo site on the northern bank of the river. The row of wells starts approximately 100 meters downstream of the refinery, so the fate of the supply depends on protecting the infiltration galleries from contamination that might migrate from the refinery or elsewhere upstream. All stakeholders identified the potential contamination of the water supply wells as a risk. UNEP, in close cooperation with the local stakeholders and German partners, has constructed a hydraulic barrier, repaired the leaking wastewater collector and established integrated monitoring activities to protect the area's drinking water sources. Removal of the sources of potential contamination, however, should continue to be a priority both in the short- and medium term.

The refinery has a well-functioning physio-chemical **wastewater** treatment plant. Treated wastewater is discharged into the repaired wastewater collector, which leads to the Danube River. Secondary biological treatment is not undertaken currently in the refinery, but will become necessary once the disposal standards to Danube are tightened. Removed oil is returned to the process stream. The refinery's extensive **wastewater collection system**, however, has deteriorated, and its condition was further degraded by the 1999 bombing. The system is segregated: one part for oily waste, the other for sewage. Many of the pipes have corroded, and the two underground lines having been interconnected at places. Hydrocarbons have migrated along the pipelines and have entered soil wherever there are breaks in the pipeline. As a result, the entire factory site is potentially contaminated with hydrocarbons. Due to budget constraints, a project for rehabilitation of the sewage system at the refinery, also identified in the UNEP Feasibility Study, was not implemented within the UNEP Clean-Up Programme. The refinery, however, in cooperation with national authorities and Czech partners, has initiated efforts to rehabilitate the sewerage system. (see Annex 2).

NIS-RNS is managing various forms of **waste**, including hazardous sludge (contaminated with catalysts and butyl mercaptan) ferrous metals and aluminum; contaminated soil, waste oil and general waste. Waste chemicals and contaminated soils are temporarily stored in a concrete-lined former tank farm. Wastes from various locations on site have been brought to this area.

According to management, approximately 8,000 m^3 of hydrocarbons leaked onto the ground during the NATO bombing. Management also told the assessment team that there had been no major oil spills at the site prior to the Kosovo conflict, except for an accident during barge loading. More recently, in August 2003, the refinery experienced a spill that affected the Danube River. Today, there is widespread visual evidence of **soil contamination** from oil along pipes and drainage ditches. Due to budget constraints, a project for soil remediation at the refinery, also identified in the UNEP Feasibility Study, was not implemented within the UNEP Clean-Up Programme.

Oil stains on soil and manhole at NIS Oil Refinery, Novi Sad

Tetraethyl lead (TEL) tanks were also damaged by NATO bombing. The tanks were not perforated, however, so no TEL was spilled. Nevertheless, damage to the leaded gasoline tanks and spilled gasoline caused TEL contamination of groundwater in this area of the site. Washout from contaminated soil threatens to spread pollutants into and via the groundwater table. If the site is not cleaned up, the cost of environmental legacies will be internalized into the cost of the facility during any valuation of the industry, thus reducing its equity.

According to **air quality** monitoring results, Novi Sad's air is slightly to moderately polluted. The main air pollution sources from the refinery are fugitive emissions of VOC and smoke from the power plant and flare. In 2000, the annual average concentrations of sulphur, nitrogen dioxide and soot were below ambient air quality limit values, but 10% of the daily concentrations exceeded the limit value for all measured pollutants.[39] Although VOC compounds were not monitored, there are many VOC emission sources, including the gas and crude oil storage tanks, loading and unloading operations, and the filling station, which has no vapor recovery system. Two power plant boilers each produce 50 tonnes of steam per hour by burning natural gas, process gas and oil. An open-air waste basin that stores large amounts of oil-contaminated soil and waste also emits VOCs and odors that are a nuisance for local residents, especially during warmer summer months.

The facility has a waste oil sludge incineratorthat is fueled by natural gas. When it was operational, two cubic meters per hour of waste oil sludge were incinerated at 900^0C. The incinerator has not operated, however, since the end of 2001.

Site Recommendations

Priority action

- Establish a land farm for treatment of the oil-contaminated sludge stored within the refinery.
- Consider establishing open capture trenches in areas identified as having gross hydrocarbon pollution and using skimmers to accelerate recovery of oil.

Medium-term action

- Undertake a Phase II environmental site assessment to identify areas contaminated by hydrocarbons and other chemicals and to develop strategies for remediation and clean up.
- Repair/replace the wastewater collection network.
- Review the potential for using the existing pipelines as a gathering system for contaminated groundwater by applying negative pressure.
- Review the need for secondary biological treatment of wastewater to ensure that the disposal to Danube will meet EU requirements

3.2.2 Institutional Capacity to Protect the Environment

In 1992, Novi Sad declared that it would move "toward an ecological state". In furtherance of this goal, the city introduced an **"ecotax"** in 1995. The ecotax has enabled the creation of a seven-person municipal Environment Department that in 2003 had a budget of approximately 500,000 Euros. The Department conducts monitoring, coordinates projects and campaigns, publishes information, including an eco-bulletin, and works in cooperation with other governmental and nongovernmental organizations. At the time of the assessment mission's visit to Novi Sad the municipality was preparing to elevate the Department to the status of an **environment secretariat** and to double its staff size to fifteen.

Municipal and other local stakeholders in Novi Sad have shown strong commitment to the objectives of the UNEP Clean-Up Programme and have generally expressed satisfaction with the measures implemented by UNEP to protect the drinking water sources at Ratno Ostrvo. Due to budget constraints UNEP has not been able to implement all of the projects identified in the Feasibility Study. All stakeholders, however, and in particular the NIS-RNS agree that further remediation of the contaminated zone should occur as soon as possible.

The municipality is in the early stages of developing a **LEAP**. During 2001 and 2002, the city published environmental reports that outlined its environmental priorities and projects. Projects and funding decisions are made by a group of appointed stakeholders. The provincial Secretariat for Environmental Protection and Sustainable Development, established in 2002, has also developed an Ecofund, which has been co-financing certain municipal projects.

According to municipal officials, the city's current **environmental priorities** are pollution from large industrial facilities; improper disposal of municipal and medical waste; the absence of wastewater treatment; inadequate measurement and control of air pollution sources; and the need for preparing a comprehensive environmental action plan such as a LEAP.

Municipal officials in Novi Sad expressed concern that the city lacks the equipment and training necessary to gather **environmental data**. The Institute for Public Health (IPH) – Novi Sad monitors air, groundwater, surface water, drinking water, noise and food. The municipal water and sewer enterprise, Novi Sad Waterworks, also monitors drinking water quality and, once a year, wastewater. In 2002, the University of Novi Sad's Faculty of Sciences and Mathematics developed a cadastre of industrial wastewaters.

IPH-Novi Sad sends **air quality** data to the municipality, the province, relevant ministries and the republican IPH (Institute of Public Health – Serbia) on a monthly and yearly basis. The key sources of air pollution are the oil refinery, traffic, residential heating and the local cement factory. The municipal heating plant burns coal and emits levels of sulphur dioxide that are occasionally problematic in the winter. As the plant shifts from coal to gas fuel, however, this problem should be alleviated. The cement factory emits suspended particles, but the municipality lacks the equipment necessary to monitor particulate matter.

The municipality's ten environmental **inspectors** have the authority to inspect air, noise, water and greenery at small enterprises and to halt unlawful activities and/or refer cases to the public prosecutor for civil action. According to local authorities, however, the city lacks the environmental data necessary for prosecutions. The pending Law on Environmental Protection is expected to clarify environmental management responsibilities on the republic and municipal levels and to strengthen enforcement.

Wastewater management is an urgent challenge in Novi Sad. The urban areas of Novi Sad are connected to the city's 860-kilometer sewer system that discharges untreated communal and industrial wastewater into the Danube River. The remainder of the city's settlements use septic tanks. The sewer system's discharge points are located near the extraction areas for the city's drinking water supply. The recent repair of the refinery's collector and relocation of its outlet to a point downstream of the Ratno Ostrvo extraction area (see UNEP clean-up project and the recent extension, funded by EBRD, discussed above), however, has partly reduced this risk. During 2001, the municipality developed a master plan that includes projects to move the

most important wastewater discharge points (estimated to cost 20 million Euros) and to construct a wastewater treatment plant (estimated to cost 16 million Euros). There is also a project to upgrade the sewer system. Outside the city, agricultural runoff, particularly from pig farms, is an additional water pollution concern.

Novi Sad's Department for Communal Services is responsible for **waste collection and disposal**. The municipality's controlled landfill receives communal, hazardous and medical waste. Efforts to separate paper and plastic have begun. Because the landfill is located near a marshland, local officials are concerned that leachate may be contaminating the groundwater. The municipality is making plans to extend the existing landfill and is studying the creation of a medical waste installation. In addition, the National Strategy on Waste Management calls for the creation of nine regional landfills in Vojvodina. Municipal officials anticipate that one of those landfills will be located in Novi Sad. Adoption of a draft law on waste and the pending framework law on environmental protection will also further influence the municipality's waste management policy.

Novi Sad's **drinking water** is abstracted from the alluvial aquifer, which is being recharged by the Danube River. According to local authorities, the drinking water quality is generally considered to be good. The public waterworks and sewerage utility manages the delivery of water, which costs 20 dinars (approximately 0.28 Euros) per cubic meter. The city's average daily water consumption of 175 liters/person/day is compounded by leaks and illegal connections that are causing the distribution network to lose up to 30% of its supply.

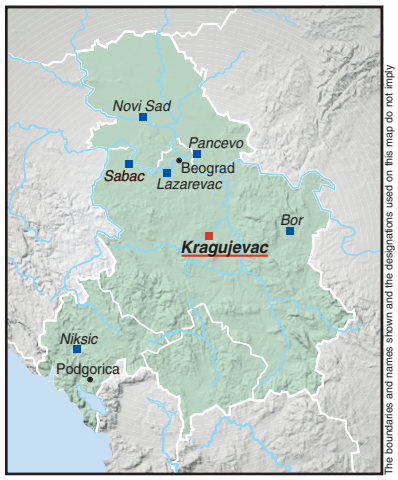
Novi Sad's **NGO community** consists of a handful of active organizations that are focused principally on building public awareness about environmental issues relevant to the community. Vojvodina province has a smaller percentage of forest-covered land than other parts of Serbia, making forestation and the creation of green spaces an important local priority. The NGO community depends on the municipality for financial assistance, and the groups tend to opt for a consensus-building approach to solving local problems.

Recommendations

- The city's plans to treat its wastewater and to move wastewater discharge points should be assigned the highest priority and supported by national authorities and the international community.
- In order to be sustainable, the municipality's drinking water system needs to reduce water losses through an accelerated programme to repair and replace leaking network pipes. In addition, the municipality should promote water-saving measures for industrial and domestic consumers.
- Consistent with the National Strategy on Waste Management, hazardous and medical waste that is currently being deposited in the municipal landfill should be separated and securely controlled. This is particularly urgent because landfill leachate may be contaminating the groundwater supply. In addition, plans to construct a regional sanitary landfill should be given full support, but should not serve as a basis for delaying steps to limit pollution at the existing landfill.
- Authorities on the republican and regional levels should assist pig farmers with devising low-cost strategies to minimize runoff.
- Organic farming should be promoted to take advantage of fertile soil quality and reduce future reliance on pesticides.
- Local efforts to control air pollution could be enhanced by the acquisition of high-resolution air monitoring equipment capable of detecting particulate matter and VOCs.
- The municipality's new environment secretariat should assign a high priority to building public awareness and creating transparent information systems. The LEAP process, which can catalyze action while building trust and awareness, should receive continued support.
- Local NGO initiatives to promote green spaces and, e.g., the creation of a Danube ecological education centre, are deserving of support and assistance.

3.3 Kragujevac

Kragujevac is the major city in Serbia's Sumadija region. The city is best known for its weapons munitions and car factory, Zastava, which produces Yugo automobiles and other vehicles. Located 140 kilometers south of Belgrade, along the Lepenica River, Kragujevac has a population of approximately 200,000. The Lepenica River is a tributary of the Velika Morava, which in turn flows into the Danube River some 60 km downstream of Belgrade.



3.3.1 Site Assessments

Zastava Group of Companies

Key Environmental Issues

- Environmental management responsibilities for complex's shared facilities not clearly delineated
- Waste storage locations spread around the site, some accessible to public and children
- Discharge of untreated wastewater to the Lepenica River
- Fuel storage tank next to the river with potential to leak or spill and cause contamination
- Inappropriate storage of PCB-containing equipment; PCB-contaminated site
- Air pollution from power plant and painting process

Site description

The Zastava factory once employed 36,000 and produced 200,000 autos per year, making it among the largest industrial facilities in Southeastern Europe. The company complex occupies 60 hectares, over half of which is used for manufacturing. More recently, increased competition and the loss of formerly captive markets, together with the effects of the former economic embargo, have caused steep drops in output. The plant now produces less than 1,000 cars per month. Still, a large percentage of Kragujevac's population depends on the Zastava factory for their livelihood, and the factory provides a number of secondary products and services including heating for a significant part of the town.

The "Zastava" complex is an integrated vehicle and military hardware manufacturing plant. The complex includes the following companies:

- "Zastava Automobili" and "Zastava Kamioni" (machining, stamping, car and vehicle body, assembly, and surface protection/paint shops);
- "Zastava Namenska" (producing weapons and munitions);
- "Zastava 21 Oktobar" (producing plastic interiors/trims for vehicles);
- "Zastava Kovacnica" (the forge plant);
- "Zastava Alati' (producing tools);
- "Zastava Energetika" (the energy plant);
- "Zastava Masine" (producing various equipment); and
- a trade and servicing centre.

The complex's energy plant includes a power station that provides electricity to the rest of the complex and district heating to the municipality. The power station is fuelled by a combination of lignite and brown coal and uses heavy fuel oil during start-up.

Although Zastava has had difficulty positioning itself in the market economy, the possibility of privatization and collaborations with international brands offers hope that the factory will turn itself around.

UNEP Clean-Up Programme[40]

The Zastava complex was targeted twice in April 1999, with NATO bombing causing heavy damage to the facilities, including the power station, car assembly line, paint shop, computer center, and truck line. Some areas of the facility were completely destroyed. The main concerns identified by UNEP´s post-conflict assessment were the high concentrations of PCBs and dioxins detected on the "Zastava Automobili" paint hall floor and in nearby wastewater pits; PCBs within the "Zastava Energetika" power plant's transformer station; and sediments in the Lepenica River.[41]

Remediation of PCB - contaminated concrete floor at "Zastava Automobili" paint hall

Project Background: During the 1999 Kosovo conflict, bombing damaged two paint hall transformers containing PCB oil. Approximately 2,150 kg of PCB oil leaked out of the transformers and flowed onto the concrete floor and in the direction of nearby wastewater pits. Analyses of samples taken during UNEP missions in 1999 and 2000 showed high levels of PCBs and PCDD/Fs (dioxins and furans) in the debris on top of the floor. Further investigations by UNEP in 2001 confirmed that PCBs had penetrated approximately 150 m^2 of the paint hall's concrete floor to a depth of approximately 25 centimeters, contaminating the soil below in some places. As much as 30,000 mg/kg of PCBs were found in the top layers of concrete near the former transformers, while elsewhere in the paint hall the concentrations were less than 50 mg/kg. Approximately 400 m^2 of less contaminated concrete was identified in the remainder of the paint hall and in the area toward the new basic paint pit. Dioxins and furan concentrations in the concrete were very low, making PCBs the parameter of concern for the clean-up project.

Project Objectives: The risks arising from the PCB contamination primarily involved exposure of the paint hall workers. Accordingly, the project's objectives were to reduce health risks for factory workers, to avoid further cross-contamination and to pack and store waste properly so that it could be transported in the future (see below).

Project Achievements: UNEP, in close cooperation with the "Zastava" car factory and the University of Kragujevac's Institute of Chemistry, started implementation of the project in December 2001. Contaminated layers of concrete/soil were removed and packaged, accompanied by verification of decontamination. New soil/concrete layers and anti-static epoxy resin was placed over the concrete. The clean-up target was to reduce PCB concentrations in the remaining material/soil to less than 50 mg/kg. This target was reached and thereafter the soil was covered with concrete and epoxy layers. Damaged transformers and debris caused by the conflict were also removed. A total of 135 tonnes of hazardous waste resulting from clean-up activities was characterized, properly packed, labeled, temporarily stored and later transported and incinerated abroad. These activities have allowed reuse of the affected part of the paint hall. The work was completed in August 2002.

Cleaning of the wastewater pits and decontamination of the wastewater in "Zastava Automobili" paint hall

Project Background: PCBs leaking from the two transformers damaged by the bombing reached the open wastewater pits in the Zastava paint hall and mixed with water, paint sludge, and debris. Because the PCB oils are denser than water and not very soluble, they were mainly confined to the sediment at the bottom of the pits. The total quantity of PCB -contaminated wastewater in the pits was 6,000 m^3.

Project Objectives: The project objectives were to reduce health risks to factory workers, to avoid further cross contamination, to protect water resources from further contamination (in particular through uncontrolled sewerage discharges to the Zdraljica River and the Lepenica River) and to properly pack the clean-up waste, so that it could be transported later.

Project Achievements: UNEP, in close cooperation with "Zastava" car factory and the University of Kragujevac's Institute of Chemistry, started implementation of the project in August 2001. Approximately 6,000 m^3 of PCB-contaminated wastewater (with a maximum concentration of 0.7 mg/l) was removed from the pits and treated using a remediation method elaborated by national experts and reviewed by international experts. After purification, the PCB content in the treated wastewater was less than 0.0005 mg/l. In total, 120 tonnes of contaminated debris and bottom sediment were removed. An additional 10 tonnes of equipment from the pits were dismantled, decontaminated and disposed. The resulting hazardous waste was characterized, properly packed, labeled and later transported and incinerated abroad (see below). The project was completed in April 2002, following verification of the decontamination works. In addition to protecting workers and improving the environment, the project enabled the decontaminated pits to be reused.

Remediation of PCB contaminated site at "Zastava Energetika" transformer station

Project Background: NATO bombing in 1999 damaged a transformer at the sub-station near "Zastava-Energetika" headquarters, causing PCB–containing oil to leak out. UNEP missions in 1999 and 2000 found high concentrations of PCBs and PCDD/Fs (dioxins and furans) in the concrete and a nearby rainwater gully. The contaminated concrete area was estimated to include 150-200 m^2.

Project Objectives: The project objectives were to reduce health risks to factory workers by removing the damaged transformer and cleaning up the site, and to enable the reuse of transformer station, which supplies the factory and provides heating to the municipality.

Project Achievements: UNEP, in close cooperation with "Zastava Energetika" and the University of Kragujevac's Institute of Chemistry, started implementation of the project in September 2002. The transformer has been removed and temporarily stored at the factory yard's access-restricted site designated for used PCB-equipment. After the removal and replacement of contaminated concrete and soil layers from the transformer pit and adjacent concrete surface, another transformer that does not use PCB oil was installed. Approximately 50 tonnes of hazardous waste was characterized, properly packed, labeled and later transported and incinerated abroad (see below). In addition to protecting workers and improving the environment, the project has enabled the transformer station to be used again.

Transportation and treatment abroad of hazardous waste resulting from Kragujevac remediation projects

Project Background: A total of 315 tonnes of hazardous waste resulting from all Kragujevac remediation projects was packed and temporarily stored on the factory premises. An approved facility for the environmentally sound disposal of hazardous waste does not exist in Serbia & Montenegro.

Project Objectives: The project's objective was to treat and finally dispose of the hazardous waste from UNEP clean-up projects in Kragujevac in accordance with environmentally sound management requirements, thus eliminating risks arising from the waste's storage on factory premises.

Project Achievements: UNEP completed the project successfully in October 2003. The project work was done in close cooperation with "Zastava" factory and competent national authorities, and in accordance with the Basel Convention on the Control of Trans-Boundary Movements of Hazardous Wastes and their Disposal.

Project specific follow-up to Kragujevac clean-up projects:

- Local and national stakeholders provided very strong input to the successful project implementation. The projects implemented in Kragujevac could be used as a case study for further strengthening hazardous waste management capacities and hazardous waste awareness in Serbia & Montenegro.

Overall site assessment

The site assessment team visited "Zastava" complex and the Kragujevac landfill on 6 November 2003.

The complex's considerable pollution problems are compounded by the fact that many of its units share facilities such as the waste disposal site, wastewater collection system and others. The responsibility for maintenance of these facilities has not been delineated, creating a situation in which major environmental management issues have not been addressed.

The factories generate various forms of **solid waste**, including hazardous waste, scrap steel, textile scraps, and used PCB capacitors. A serious problem exists with the factories' **hazardous waste**. An estimated 500 tonnes of hazardous waste has been stockpiled in 210-liter drums on a concrete area on the southern perimeter of the UP-8 site. The drums contain waste lacquers, paints, solvents (including chlorinated solvents), thinners, adhesives, and dielectric fluid. Most likely, the concrete surface is contaminated with PCBs, because the site was used to temporarily store PCB-contaminated waste after the 1999 bombing. The drums are open and superficial oil staining is evident. Impacted storm water flows down the gradient towards the facility and percolates through the soil.

Hazardous waste has also been kept in a former ammunition store on the southeastern perimeter of the "Zastava Namenska" site since 1989. Materials at the site include cyanide salts, mercury and lead-contaminated sand from munitions testing, sodium hydroxide, solidified paints, and galvanizing sludge. The waste is stored in plastic/steel drums or bags, a number of which are heavily corroded. The bunker floor is in poor condition, suggesting the possibility of soil contamination below. In addition, one PCB-containing transformer at "Zastava Namenska" was damaged during 1999 conflict and PCB-oil has leaked out contaminating the transformer pit and drainage below. The transformer and gravel from the pit has been reportedly replaced, but the site is still PCB-contaminated.

Waste storage area at Zastava

An estimated 20,000 m^3 of demolition waste from areas damaged during the 1999 bombing of the "Zastava" complex has been stockpiled near the residential area of Erdec (UP-7 site) on the site's southwest perimeter. The site is not controlled, making it possible for local residents and children to gain access. The stockpiled wastes includes concrete, brick, steelwork, pipework, asbestos insulation, damaged asbestos cement sheets, rubber, steel racks and drums.

It was reported that 43 out of a total of 76 transformers at the Zastava facility contain PCBs. In addition, 67 PCB-containing capacitors are stored in the basement of the electrical workshops. No inventory of electrical equipment, specifications or test results were made available for review.

Textile waste, including approximately 60 tonnes of carpet off-cuts, polyethylene, polyester and fabric linings, is stockpiled on the southwestern perimeter of the "Zastava" complex. The municipality will not allow this inert waste to be landfilled. In its present state, the stockpiled waste represents a fire risk.

Storage of PCB contaminated equipment, Zastava

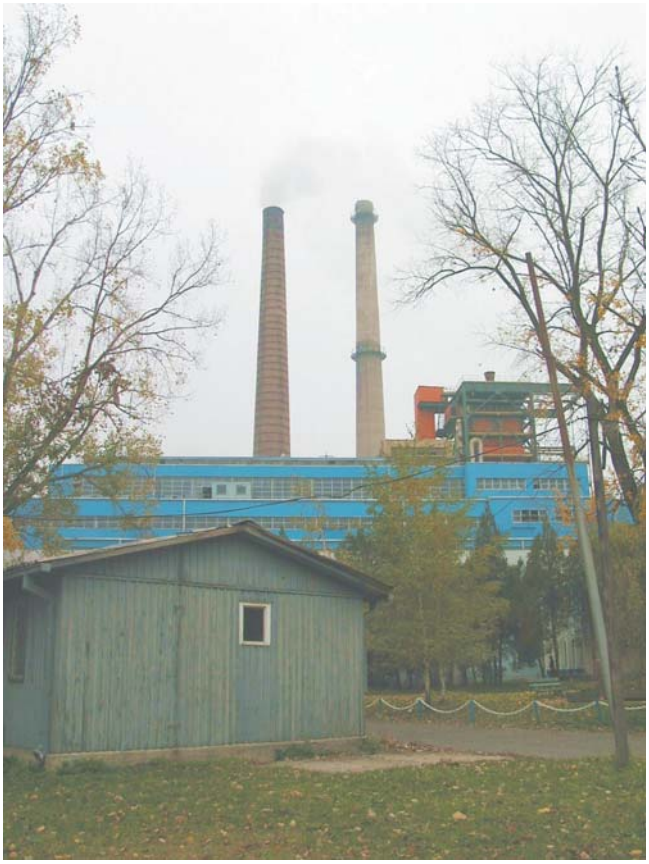
Storage of hazardous waste from galvanizing plant, Zastava

A small fuel storage tank is adjacent the Zdraljica River. There was evidence of surface contamination around the fuel storage/loading area, posing the risk of possible contamination of the river either by an ongoing leak (e.g., corrosion) or an event (e.g., spill from rupture during loading/unloading). The site had no fence line monitoring and hence no early-warning mechanism to detect leaks, should any occur.

The "Zastava" complex, including its bomb-damaged computer centre, reportedly has smoke detectors that contain radioactive americium-241. The complex also has 24 lightning rods that contain radioactive sources. If inappropriately handled and disposed, these materials could pose a risk to workers and the environment.

The "Zastava" complex had just completed construction of a **wastewater collection and central pre-treatment system** as the 1999 Kosovo conflict started. Due to economic difficulties, however, the system has never been put into operation. At present, wastewater from some plants is being discharged (with and without primary treatment) directly into the Zdraljica River and Lepenica River. Other wastewaters are being transferred to Kragujevac central WWTP for final treatment before being discharged into the Lepenica River.

Ambient **air monitoring** results indicate that Kragujevac is considerably polluted. In 2002, for example, at one of the monitoring points, soot concentrations were higher than the limit value on 20 measurement occasions. At the "Filip Kljajic" monitoring location, sulphur dioxide and soot concentrations exceeded the limit value on 16 measurement occasions. The monthly mean values of SO_2 concentration at the site were between 22 and 111 $\mu g/m^3$, while soot concentrations were between 10 and 38 $\mu g/m^3$. By contrast, the limit values for yearly mean concentrations of these pollutants are 50 $\mu g/m^3$ for SO_2 and 50 $\mu g/m^3$ for soot. That same year, the annual mean for total sedimented substances was 319 $mg/m^2/day$ as compared to the limit value of 200 $mg/m^2/day$.[42]



Stacks of power plant at Zastava, Kragujevac

The power plant is a major source of air emissions. The plant's five boilers were built between 1962-1980. They provide 28 megawatts of electricity and 450 megawatts for district heating. Seventy percent of the fuel burned in the boilers is brown coal (100,000 tonnes during cold months). The rest is lignite, crude oil and gas. The plant has two stacks that are 80 and 100 meters high, respectively. Particulate matter is removed from the flue gases with electrostatic precipitators before it is exhausted through the stacks. The precipitators are designed to remove 99.7% of the particulates. Although no information was available on particulate matter emissions, it was apparent that the precipitators are operating at well below their designed efficiency.

Another emission source is the paint used in the plant, 80% of which is solvent based. Solvent vapors from the painting line are collected and filtered to remove particulate matter. No treatment is used for the VOCs, and no emission measurements are performed.

Site Recommendations

Priority action

- Map the facilities shared by various factories in order to identify their uses and allocate responsibility for their management. An internal usage charge system could be established to apportion management costs.

- Stop the unauthorised access to all waste storage locations. Conduct a thorough review of all waste storage sites in the complex to enable consolidation of hazardous waste storage and to maximise the recycling of non-hazardous waste.

Medium-term action

- Undertake a Phase II site environmental assessment to identify areas contaminated by chemicals, PCBs and heavy metals with a view to initiating remedial and clean up actions.

- Review the management of the company's effluents to identify opportunities for segregating streams and optimising treatment.

- Conduct a risk assessment of the fuel storage next to the river and introduce risk reduction measures as appropriate including better integrity protection, fenceline monitoring or relocation.

- Remediate the PCB-contaminated site and provide for the proper final treatment/disposal of the remaining PCB/PCB-contaminated soil and equipment.

Kragujevac Landfill

Key Environmental Issues

- Improper siting and design, and no leachate and landfill gas management
- Landfill accessible to scavengers and animals
- Spontaneous combustion of waste
- Possible improper disposal of hazardous substances

Municipal landfill, Kragujevac

Site description

The Kragujevac municipal landfill is located approximately six kilometers from the city, on the flood plain of a small river. The landfill occupies approximately eight hectares and has been operational for roughly 30 years.

Overall site assessment

The landfill was not properly sited or designed. It has neither a basal liner nor gas or leachate control and monitoring systems. Part of the site has been restored to poor-grade agricultural land and is used for pasture. The landfill has not been developed in cells. Waste is simply tipped down the large, 20-meter face. At the time of the assessment team's site visit, part of the landfill was burning from spontaneous combustion and leachate ponding was visible at the base of the landfill. Although the landfill has a security post at the entrance, no tipping fees are charged and no formal system of consignment notes or designated vehicles is used. There is no organized recycling, but garbage pickers do use the site. It was reported that a new landfill had been designed and will be constructed when sufficient funding is obtained.

Site Recommendations

Priority action

- Restrict unauthorised access to the landfill site and raise awareness about risks to environment and health.
- Establish a system for recording the vehicles (e.g., driver name, vehicle number) entering the landfill to assert some control over misuse of the landfill.
- Extinguish the landfill fires, and start filling the landfill in cells. Minimise the amount of soil used for daily cover, and improve waste compaction.

Medium-term action

- Restore the landfill to minimize leachate and landfill gas generation, i.e., install a low permeability capping layer, vent systems, and leachate collection and treatment systems.
- Conduct a full assessment of leachate and landfill gas, and monitor groundwater in the area.
- Construct a new, regional landfill consistent with the National Waste Management Strategy.
- Launch waste prevention and recycling activities.

3.3.2 Institutional Capacity to Protect the Environment

Local stakeholders in Kragujevac, including the Department and other municipal officials, site owners, and relevant institutes, provided strong input to the UNEP clean-up projects at "Zastava" factory (see descriptions above) and have been satisfied with the projects' outcomes. At the same time, the UNEP projects have strengthened local environmental management capacities and catalyzed further interest and support for environmental protection in Kragujevac.

In May 2002, the municipality created its first **Environment Department.** The Department is partly financed by a small Eco-fund. The Department has its own, separate environmental specialists, but internal communication among the local authorities on environmental issues is apparently quite weak. According to local authorities, environmental awareness has, in fact, declined generally during the past decade. The Department's environmental experts and inspectors, therefore, are focused principally on sharing their expertise to increase the role of environment in municipal decision-making and to promote environmental education and awareness.

The municipal Environment Department's three-person **inspectorate** was created in 1994. The inspectors have authority to enforce air and noise violations. When necessary, cases are referred to the public prosecutor for civil enforcement actions. The local inspectors, however, do not track these cases and are generally unaware of their outcome. The Directorate for Urban Planning sets pre-conditions for construction in an urban permit, and two republican inspectors are responsible for enforcement activities against large industrial polluters. The municipal environmental inspectors, however, cooperate with republican inspectors and participate in finding solutions to the environmental problems posed by the bigger polluters.

In 2003, the Environment Department initiated a **LEAP process** that will set the municipality's environmental priorities. The LEAP team consists of technical and social teams and includes 20 stakeholders from scientific organizations, NGOs, enterprises, the Public Health Institute, municipal authorities, and public utility services, among others. During the processes' first two phases, which are expected to conclude in early 2004, the LEAP team will prepare a state of the environment report and prioritize Kragujevac's environmental problems. Members of the LEAP team have identified drinking water quality, air quality, waste collection and disposal and contaminated land as priority issues.

Air pollution is a serious concern in Kragujevac. The main air pollution sources are the Zastava factory and its power plant, the city's coal-burning central heating system, and automobile traffic. Because the city is located in a valley, sulphur dioxide occasionally accumulates in higher concentrations. The Public Health Institute monitors air quality and provides monthly and annual reports to the municipality, the media, citizens and other stakeholders. According to the Institute, asthma and bronchitis have been identified among the city's 35,000 school children, with as many as 10,000 children being affected by lung problems during the winter heating season. The Institute hopes to receive equipment in 2004 that would allow it to monitor particulate matter.

As discussed above, Kragujevac's municipal landfill is a priority environmental challenge for the municipality. The landfill was constructed thirty years ago and, at 90% of capacity, is too small to meet current needs. Various forms of **solid waste**—non-hazardous industrial, medical, plastic, glass, etc.—are mixed in the landfill. (Hazardous waste is primarily stored onsite at the factories.) An ongoing problem is that there are often fires, and noxious smoke drifts into the city only a few kilometers away. According to municipal authorities, one densely populated neighborhood is regularly burdened with high levels of smoke from the landfill. This problem is compounded by the fact that Kragujevac has numerous illegal landfills where waste is also being burned. The Public Health Institute reported that it does not have the equipment necessary to measure concentrations of dioxin and furans from burning waste.

Kragujevac's **drinking water supply** comes from two artificial lakes and groundwater sources. Although the supply is generally adequate, according to municipal authorities, the water suffers from a poor taste and smell. In particular, one source, the Gruza Reservoir, is high in organic matter, as indicated by high chemical oxygen demand values (COD). According to the Public Health Institute, however, $KMnO_4$ levels in the reservoir (laboratory method used to assess COD of water) are well below applicable limits but still undermine water quality and raise some public health concern.

Kragujevac has the largest municipal wastewater treatment plant in the Republic of Serbia. The plant, which is located eight kilometers outside the city, has been in operation since 1990. Sewage and industrial wastewater is delivered via a 23-kilometer-long canal. The plant currently removes 96% of the wastewater's pollutants before discharging the treated product into the Lepenica River, which is monitored quarterly by the Public Health Institute. Pre-treatment of industrial wastewater is weak, a deficiency that will need to be addressed as part of the economic recovery of local production facilities. The plant has begun experimenting with land application of sewage sludge under the guidance of the Institute of Public Health.

Recommendations

- The creation of the Environment Department is an important step in strengthening the municipal environmental management capacities. The municipality should ensure that the Environment Department has adequate access to information and is more fully integrated into municipal decision-making, including the urban planning process. The Department should be fully supported in its efforts to increase public awareness and promote environmental protection.

- The LEAP process offers the promise of consensus building around an environmental agenda and outreach to national authorities and potential international partners. The process deserves to be fully supported and identified priority projects implemented.

- In line with the National Waste Management Strategy the possibility of establishing a proper regional landfill should be pursued (see specific recommendations for landfill, above).

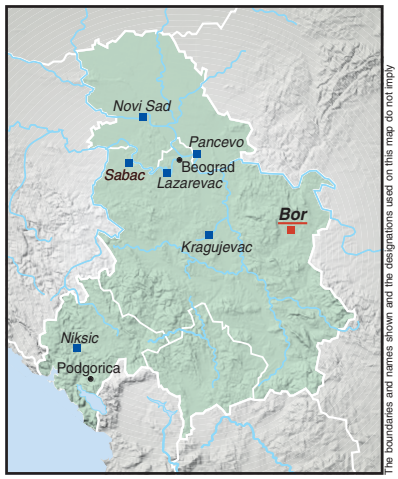
- Priority attention should be given to the health risks being posed to the population by air pollution sources in and around Kragujevac. Steps to reduce concentrations of sulphur dioxide, smoke and other pollutants should be outlined and implemented.

- Kragujevac is fortunate to have a well functioning wastewater treatment plant. Caution should be taken to ensure that industrial pretreatment processes are improved before industries increase their output.

- The problems with Kragujevac's drinking water supply require a more complete investigation. In the near term, consideration should be given to the benefits of managing water demand. Reducing overall consumption may reduce the need to use inferior source waters and higher-value potable sources for non-potable purposes.

3.4 Bor

Bor is situated in a mountainous and forested area in south-eastern Serbia, close to the Bulgarian and Romanian borders, and approximately 210 kilometers from Belgrade. The municipality has a total population of approximately 65,000, of which 40,000 live in the city of Bor. The main sources of economic activity are the mining and metal processing sectors which reportedly employ between 10,000 and 15,000.



3.4.1 Site Assessment

RTB Bor

Key Environmental Issues

- Severe air pollution from mining and smelting operations
- Extensive land and soil degradation, including loss of agricultural land and destruction of local buildings from failed pit slopes
- Potential collapse of the concrete culvert/collector running beneath flotation tailings
- Heavily contaminated industrial wastewater discharged into local receiving waters
- PCB-containing capacitors buried on the surface of an uncontrolled industrial landfill

Site description

The Bor area has been a major center for the mining and processing of copper and other precious metals for a century. Mining started in 1903 with the exploitation of an underground mine, followed by exploitation of three other open pits (from 1912, 1979 and 1990, respectively). The region has large mineral reserves. Twenty-nine ore bodies are known, including copper, gold, silver, molybdenum, nickel, selenium, germanium and minor amounts of platinum.

RTB Bor's current operations include copper ore exploitation; production of copper concentrate, pyrites, magnetite and molybdenum; smelting and refining of copper, noble and rare metals; as well as production of sulfuric acid, copper billets and blocks, copper alloys and alloy-based casts.

The company produces rolled products from copper and copper alloys (sheets and strips) and drawn products (copper, enameled, dynamo and sectioned wire, copper tubes, cables and conductors). The company also manufactures a wide palette of consumables, electro installation material, gold and silver jewelry and other products from noble and rare metals, household appliances, micro-motors, measuring transformers and insulators.

RTB Bor's main activities, however, involve the mining and processing of copper ore. Copper ore is mined from two open pits (there is also an unused underground mine). The copper residue is separated in a flotation unit, after which the 20-22% copper content of the concentrated residue is increased by flux and

roasting in a fluidised bed. The emission gases include sulphur dioxide, which is used for sulphuric acid manufacture. The copper concentrate is then fed into a convertor that produces copper anodes. The sulphuric acid is used in an electrolytic plant to further purify the final product to >99% copper. Precious metals, such as gold and platinum, are separated. Over time, RTB Bor has expanded its operations from basic mining to the entire value chain of copper and precious metals.

For a variety of reasons—the political climate and economic sanctions during the 1990s, falling world copper prices, low yield ore—RTB Bor did not invest in upgrading its production facilities. Today, the complex is saddled with poor productivity and inadequate environmental controls. Production levels are now down to approximately 10% of those during more productive periods. Although copper prices are now at a three-year high, RTB Bor has been unable to exploit the market upswing. Its technology is old; it lacks sufficient working capital to increase short-term supply; and it is obliged to maintain a constant supply to its copper processing units.

UNEP Clean-Up Programme[43]

In May 1999, NATO bombing struck RTB Bor, damaging the transformer station, TS 3, which provided the site with electricity. UNEP's subsequent assessment identified localized PCB contamination and raised concerns about severe and chronic air pollution from the mining and smelting facilities.[44]

Remedial actions concerning PCB and dioxin contamination at the transformer station

Project Background: UNEP missions in 1999 and 2000 obtained soil/sand samples at the transformer station indicating PCB values ranging from 3.35 to 682 mg/kg of soil as based on dry matter[45]. During that same period, local stakeholders took initiatives to move PCB-contaminated debris and material, including approximately 120 capacitors, from the destroyed transformer station to the RTB Bor dump site.

Project Objectives: To identify and reduce potential health risks to workers, and to enable redevelopment of the transformer station area.

Project Achievements: The risk assessment conducted by UNEP in September 2001 concluded that no further remediation measures were needed at the transformer stations site. In 2002-2003 a new transformer station was erected at the same site with Norwegian funding. UNEP's risk assessment of the RTB Bor dumpsite, where PCB debris had been placed, was finalized in February 2003.[46] The assessment indicated that there were no immediate risks to groundwater resources from PCB contamination, but recommended measures to protect worker health and to reduce risks at the site. In December 2003, UNEP removed, packed and transported abroad for final treatment approximately 150 PCB-containing capacitors. The capacitors had been removed from damaged transformer station TS 3 and stored in the vicinity of the RTB Bor dumpsite.

Project specific follow-up to: Remedial actions concerning PCB and dioxin contamination at the transformer station

- Implement UNEP's risk assessment recommendations to protect the health of workers at RTB Bor, including limiting access to the dump site.

Overall site assessment

The assessment mission visited the industrial facilities on 7 November 2003.

For several decades, RTB Bor has been the driving force behind Bor's economic growth. The company's mining activities, however, have also left behind a devastating **legacy of environmental problems**. Less

that 0.5% of the material mined in Bor is copper. All the rest—the remaining 99.5% of the material—is either solid or liquid waste that contains such toxic components as sulphur, arsenic, lead, cadmium, and mercury, to name only a few. On a more visible level, the mining process has converted approximately 1,800 hectares of local land into open cast quarries and turned what was once an agricultural village into a large industrial city centered around the heavily polluted mining and smelting complex.

Air pollution sources at Copper Smelter , with industrial landfill (front), RTB Bor

Air emissions from the plant are a major environmental problem for the region. The main sources for emissions are the smelting process, the power plant, the open cast pits and the tailing pond. In 2002, RTB Bor estimated that the plant emitted approximately 70,000 tonnes of sulphur dioxide, several hundred tonnes of heavy metal-contaminated particulates, 360 tonnes of arsenic, 83 tonnes of lead, 830 tonnes of zinc and 0.1-0.2 tonnes of mercury.[47] These high figures are nevertheless lower than the levels of emissions during the plant's high production periods, during which approximately 250,000 tonnes of sulphur dioxide, 1,000 tonnes of heavy-metal contaminated particulates, 1,000 tonnes of arsenic, 500 tonnes of lead, 2,500 tonnes of zinc and 1.6 tonnes of mercury were emitted annually.[48]

The smelting process burns coal, heavy fuel oil and timber as fuel and emits large amounts of particulate matter and heavy metals, especially arsenic and cadmium. An electrostatic precipitator is used for particulate matter removal, but the equipment is in poor condition. The smelting process also emits an enormous quantity of sulphur dioxide during the copper concentrate process: only 65% of the sulphur dioxide gas can be recovered in the sulphur acid plants, the remaining 35% is emitted to the atmosphere. Two of three existing sulphuric acid plants are in use. The plants process gas with high concentrations of sulphur dioxide, while gas with too little sulphur dioxide and excess gas is exhausted through stacks. According to the site personnel, an investment of 100 million Euros would be required to install technology that could reduce the sulphur dioxide emissions sufficiently.

The environmental consequences of the smelting plant are greatly worsened by its relatively close proximity to Bor's residential areas and the area's mostly mountainous topography. Not surprisingly, monitoring results show the ambient air quality to be poor. Sulphur dioxide and particulate matter concentrations are particularly high. In 2002, sulphur dioxide concentrations exceeded the limit value 123 times at "Opština" municipal monitoring station. On occasion, the sulphur dioxide concentrations have even briefly exceeded the measuring range of the monitoring equipment (10 000 $\mu g/m^3$). High emissions caused the plant to be shut down ten times during 2003.

RTB Bor's power plant supplies power to the complex's processes and provides district heating for Bor. The power plant burns mostly lignite and brown coal (with sulphur content <1%) and, consequently, emits sulphur dioxide. Electrostatic precipitators and cyclones, however, help to abate particulate matter emissions. Captured dust is deposited in RTB Bor's industrial waste landfill. Other sources of dust emissions are the company's tailings ponds, which encompass over 60 hectares.

Degraded arable land along Borska river

Open cast mining has caused severe **land and soil degradation** in the area. Failed open cast slopes have cause the collapse of local buildings and pose a significant local safety threat. Local stakeholders in Bor estimate that dust from mining, smelting and waste has degraded approximately 1,300 hectares of fertile land that would otherwise be suitable for farming. Open cast mine pits also become convenient dumping places for all type of wastes that can release leachate into the soil and contaminate surrounding land and watercourses. The regular discharge and dumping of solid wastes downstream of Bor, particularly at the confluence of the Bor and Timok rivers, has degraded other agricultural land in the area.

Flotation sludge from the plant is currently directed into an artificial lake. The tailings from the flotation units are transferred via a concrete culvert to two large flotation-tailing landfills: Bor RTH and Velik Krivelj. Bor RTH is located in the valley of the Borska River, Velik Krivelj in the valley of the Kriveljska River. Velik Krivelj was created by culverting the river and constructing three earth-filled dams (up-stream, mid- and down -) to

Tailing pond at RTB Bor

create two tailings fields that have volumes of 94.3 million and 89.4 million cubic meters, respectively. A pumping station in the second tailing field, Tailing Field 2, recycles the tailings water back to the flotation units. A concrete culvert that is three meters in diameter runs beneath Tailings Field 2 for a length of 2,060 meters. The culvert has started to degrade. Its collapse could result in catastrophic release of the tailings down the valley of the Kriveljska River, Timok River and, ultimately, to the Danube River. RTB Bor has commissioned a consultant to assess potential remedial options. The preferred option is to construct a river diversion tunnel through bedrock to bypass the old culvert, which would be abandoned and secured. The project has an estimated cost of 7-8 million Euros.

In addition to concerns about the culvert, the tailing fields emit dust that is high in heavy metal content. In order to minimize dust emissions, 26 hectares of Tailings Field 1 has been restored. RTB Bor has also resettled 184 households from the neighboring village of Ostrelj and has created agricultural sanitary zones around the tailings landfills. Local farmers have been offered compensation in exchange for not selling or consuming their produce.

RTB Bor has numerous **industrial wastewater** sources, including effluent from the mining process, the sulphuric acid plant, electrolyte plants, the gold plant and the smelter plant. RTB has its own wastewater system, however, which has been out of operation since 1993. Approximately 20 m^3/hour of untreated wastewaters with a pH value of 1 are being discharged directly into the Borska River. In addition, wastewater from metallurgical processes is being collected in a central lagoon and pumped over the Bor RTH flotation tailings landfill to the Borska River. This wastewater includes large quantities of sulphuric acid, suspended matter, copper, arsenic, lead, zinc, cadmium, mercury, iron, nickel, antimony, chlorine and other pollutants.

Water courses contaminated by industrial wastewaters: confluence of Borska and Kriveljska rivers

According to site personnel, a plant treated all of the metallurgical wastewaters, until it became inoperative in 1993. At the time, precipitated sludge was removed and deposited in a hazardous waste landfill underneath the 60-hectare flotation tailings landfill that is located southeast of the power station. RTB Bor estimates that 3 million Euros are required to rehabilitate the wastewater treatment plant.

An **industrial waste** landfill located nearby has an approximate waste depth of 40 meters. The landfill was developed on the permeable bedrock of the Borska River after it was diverted. The landfill contains slag, ash, brick, concrete, tires, plastic drums and demolition waste from the destroyed Transformer Station (BOR TS 3), including 170 capacitors. (See also UNEP Risk Assessment, February 2003.)[49] During the assessment team's visit, a total of 73 damaged capacitors were visible on the landfill surface. The site has not been

monitored and has no basal engineering, landfill gas or leachate control systems. RTB Bor has recently launched activities to reprocess landfill slag for recovery of copper.

In addition to waste dumped in the landfill, RTB is storing PCB-containing capacitors in a shed and hazardous chemical waste in various locations. A contractor reportedly recovers and recycles waste oil.

PCB-containing capacitors on the surface of an uncontrolled industrial landfill, RTB Bor

Site Recommendations

Priority action

- Make funds available to complete the risk assessment study of the flotation dams/collector and bring findings to the immediate attention of national government authorities so that urgent measures can be taken to avoid a potential event that would have significant regional and trans-boundary environmental consequences.

Medium-term action

- Conduct a thorough review of air emissions from the smelting process and identify technological options (e.g., change in process, end-of-pipe technologies, plant relocation, etc.) that would reduce emissions and associated health risks to workers and the community. The findings should be incorporated into the company's privatization agenda.

- Consider establishing an environmental restoration fund that could obtain its revenue from an environmental tax per tonne of ore extracted. The fund could be used to initiate environmental restoration (revegetation, slope stabilisation, compensating relocated communities, etc.).

- Undertake a Phase II site environmental assessment to identify the areas of the plant that have been contaminated by chemicals, PCBs and heavy metals, with a view to initiating remedial action.

3.4.2 Institutional Capacity to Protect the Environment

At the end of 2003, Bor successfully completed its **LEAP.**[50] A civil forum comprising 48 stakeholders and chaired by the deputy mayor has been the principal decision making body of the process. The civil forum including NGOs, municipalities, scientists, medical and academic institutions and other experts developed the LEAP with advisory inputs from a 25-person expert team. The municipal assembly reviews and approves all LEAP proposals. The municipality, the government and UNEP have provided technical and/or financial support to the process.

Bor's local officials, site owners and other stakeholders strongly supported and cooperated with UNEP's efforts in Bor and expressed their appreciation for UNEP assistance. The Bor stakeholders have strongly encouraged UNEP to continue its support in order to catalyze the assistance of Serbian authorities and international partners in addressing Bor's considerable environmental and economic problems.

The **municipality's environmental competence** is currently limited to two inspectors who enforce air and noise regulations and cooperate with two locally based republic inspectors in cases involving large polluters and other matters outside their limited jurisdiction. Two LEAP team members, however, have recently become municipal employees. The two are expected to form the core of a new municipal environment department after the next municipal elections in 2004. At that point, it is anticipated that the LEAP office will serve as a local environment agency that will implement projects and complement the environment department's policy role.

Bor's **water supply** comes from four underground sources and, according to municipal authorities, is generally of good quality. The water is sampled twice weekly from 10 locations and has routinely been within applicable drinking water limits. The municipal supply travels through a 200-kilometer distribution network to reach 55,000 connected consumers in Bor and surrounding villages. The network is currently losing up to 40% of its supply. In 2002, Bor initiated a pilot project to upgrade the network's failing pipelines and to construct an artificial lake. The repairs reduced network losses to 35%, but the area's highly acidic soil continues to cause corrosion. Despite consuming a high daily average of 300-320 liters per capita, only 42% of residential customers pay their monthly bills of 14.5 dinars/month (approximately .23 Euros). Even worse, industries pay 41 dinars/month (approximately .57 Euros), but nearly 80% do not pay their bills. At the time of the assessment mission, RTB Bor, a major consumer of municipal water, owed the municipal utility considerable amounts of money, forcing the utility into arrears with its electricity supplier. To date, the utility has not explored water conservation strategies to reduce consumption and minimize system losses.

Approximately 95% of Bor's households are connected to the municipal **sewer system**. At present, all wastewater is discharged into the Borska River. The municipality, however, has financed and completed designs for a project to reconstruct the sewage system and construct a wastewater treatment plant. The municipality is also particularly interested in renovating a decaying wastewater collector that runs under Bor RTB's waste tailing landfill (see Overall site assessment section above). Industrial wastewater is not being pretreated by industrial facilities in Bor.

Bor's **municipal solid waste landfill** is situated in a part of the mining complex that is close to town. The landfill is not sanitary, has no system for leachate treatment or landfill gas collection and is not being properly managed. Medical waste is containerized and mixed in with municipal and other organic waste. Regular fires at the site have further increased the already apparent risks to the environment and public health.

The Bor Medical Center has participated in the LEAP process and has organized events promoting environmental health awareness. The Center's equipment is old and in need of upgrading in order for the Center

to perform public health studies. Through the LEAP process, however, and with the assistance of UNEP, Bor has obtained two stationary and two mobile air monitoring stations that providing the Medical Center with data on sulphur dioxide concentrations. There is no separate Institute for Public Health in Bor, the nearest one being in Zajecar.

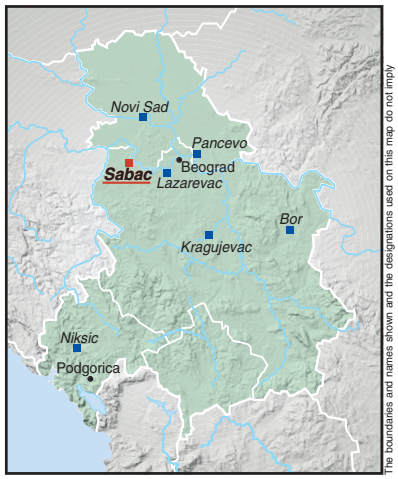
Bor has a vibrant **NGO community** that has been deeply involved in the LEAP process. The organizations, which includes Eastern Europe's largest scouting group, are principally focused on environmental education, building public awareness, protecting local biodiversity and improving citizen access to the outdoors. According to one NGO leader, however, the NGO community's efforts will be in vain unless the environmental problems of the mine can be alleviated. The NGOs are generally lacking in resources and need better access to environmental education and other informational materials.

Recommendations

- Local and national authorities should increase their efforts to find a long-term strategy to address Bor's wide-scale socio-economic and environmental problems.
- Bor's LEAP deserves to be financially assisted and fully supported by the state government and the international community, so that identified priority measures can be rapidly implemented and new sustainable economic development opportunities promoted in the Bor region.
- The municipality should seek support for a multi-dimensional programme to repair and replace its water supply network, promote wise use of water and increase bill payment rates. The strategy might include a combination of financial incentives, public education and awareness building, increased enforcement and negotiated settlements of large debts.
- Reconstruction of degraded wastewater collectors – particularly the section under the Bor RTB tailing landfill – is an urgent priority that deserves the support of the government and the international community (see Overall site assessment, above).
- The municipality's plans to construct a wastewater treatment plant deserve priority consideration for technical and financial assistance.
- Consistent with the National Strategy for Waste Management, low-cost measures should be taken to eliminate fires in the municipal landfill, and plans should be accelerated to construct a sanitary landfill. Medical waste should be safely handled and disposed and staff trained accordingly.
- Cooperation between the IPH in Zajecar and Bor Medical Center should be strengthened to ensure that activities are coordinated and limited resources are used in the most efficient manner.
- The NGO community's efforts to promote environmental education and awareness should be supported

3.5 Sabac

Sabac is a city of approximately 55,000 that is located in northwest Serbia on the bank of the Sava River. The city's economy has been dominated by the Zorka chemical complex, which includes a zinc smelter and plants for the manufacture of fertilizer, plastics and ceramic tiles.



3.5.1 Site Assessments

Zorka industrial complex[51]

Key Environmental Issues

- Environmental management resposibilities for the complex's shared facilities are not clearly delineated
- Storage of gypsum slurry next to the Sava River, as well as storage of hazardous waste (jarosite) in an unlined and unprotected landfill, may be polluting the Sava River
- Additional hazardous and non-hazardous wastes stored in an unlined and unsecured location
- Ammonia and other air emissions
- Improperly closed facilities (eg. pesticides plant) posing environmental risks

Site description

The Zorka facility has a number of industrial units (including Zorka Holding Company, Pesticide Plant, Plastic Packaging Plant, Fertiliser Plant, Zinc Electrolysis Plant, Zinc Galvanising Plant, Ceramic Tile Plant, Plastika and Poliplast – plastics production plants, Research Center and Plasticiser Plant). Some of these plants are functional, others are not. The Zorka Holding Company is a supplier of central services and the joint owner of all of the plants. The factory management suggested that the UNEP team focus attention on two environmental issues: the storage of jarosite and gypsum. The plant's industrial units, however, often share land and facilities, so the assessment team had occasion to observe a number of additional issues during its site visit.

While the Zorka industrial complex may have once afforded synergies and efficiencies to its individual businesses, today the estate presents a number a significant environmental management challenges. Many of the industrial units are either dormant or are in the process of privatizing. The future responsibility for managing the complex's environmental legacies is unclear, particularly in cases where an enterprise is jointly owned.

Overall site assessment

The site assessment team visited the site on 8 November 2003.

The complex's main environmental problem is a landfill for the disposal of jarosite. Jarosite is a **hazardous waste** product of the zinc smelting process. Each day, the zinc plant reportedly generates approximately 60 tonnes of jarosite, which has 10% zinc and 30-32% iron content.[52] The landfill currently holds 160,000 m^3 (520,000 tonnes) of jarosite. The four-hectare landfill is subdivided into nine sectors, has an approximate height of four meters, and is relatively flat. Storm water and excess wastewaters run off into the Sava River, which later merges with the Danube River. Although access to the main discharge point was not possible, it is likely that, in addition to jarosite, the runoff contains suspended solids, cadmium, copper, lead, mercury and arsenic. It is estimated that, at the current rate of production, the landfill will reach its capacity in approximately five years.

Wastewater discharge and storage of gypsum slurry next to Sava River, Zorka industrial complex, Sabac

Phosphatic gypsum, a by-product of fertilizer production, is being dumped as a slurry on the bank of the Sava River. Although phosphatic gypsum is not toxic, wastewaters containing phosphatic gypsum tend to be acidic, and rapid settlement following discharge produces bright white deposits that can cause dust problems during the summer months. Part of the gypsum is being re-used. If well managed, gypsum storage is not a major environmental issue.

The facility has other **solid waste** challenges as well. Quantities of soil, zinc pyrite, plastic drums, steel, construction waste, roasted pyrite slag and jarosite waste have been stockpiled in the center of the facility. Public access to the waste area is not restricted, posing risk of dermal contact and dust inhalation to workers and visitors. The waste stockpile also has the potential to runoff and impact surface and groundwaters.

Industrial waste disposal site, Zorka complex, Sabac

Storage of hazardous waste (jarosite) in an unlined landfill at Zorka complex, Sabac

One of the main sources of **air emissions** from the Zorka complex is ammonia from the fertilizer plant. Although the plant has a scrubber unit, the equipment is old and is not currently functioning. At times, the factory has closed down its operation due to complaints. The scrubbers' use of phosphoric acid also creates a secondary problem: its sludge is neutralized with lime and discharged into the Sava River. Other air emissions include fluorides from the phosphoric acid plant and SO_2 levels that commonly exceed limit values during start-up of the sulphuric acid plant.

Most of the complex's plants and machinery are old and poorly maintained. The storage of acids and other chemicals is a particular concern. It was reported that a pesticide factory within the complex is no longer functional. It was not clear, however, if the stocks of pesticides or pesticide precursors have been properly destroyed and the land decontaminated.

Air emissions from Fertilizer Plant at Zorka complex, Sabac

Ambient air quality monitoring performed during the first six months of 2003 found that ammonia, soot and hydrochloric acid concentrations were periodically exceeding limit values. The highest ammonia concentration was 336 $\mu g/m^3$, as compared to a limit value of 200 $\mu g/m^3$. Air quality sampling carried out in September 2003 found fluoride concentrations in excess of the limit value during two out of three monitoring days.[53] Because the facilities were constructed prior to 1991, they have not been subject to approval or permits issued by the national environmental authorities.

To supplement the municipal water supply, portions of the plant abstract groundwater from boreholes on the premises. In view of the industrial nature of the area and the storage of numerous hazardous chemicals, however, the possibility of groundwater contamination cannot be ruled out.

Site Recommendations

Priority action

- Map the facilities shared by various factories in order to identify the uses of common facilities and allocate responsibility for their management. Use charges could be applied internally to apportion the cost of management.
- Initiate periodic monitoring of the runoff from the jarosite and gympsum dump to the Sava River.
- Install a settling chamber prior to final disposal of the runoff water.

Medium-term action

- Review the storage condition of the jarosite waste in order to understand its stability and potential for environmental contamination. Initiate remedial measures, including potential re-use, as appropriate.
- Undertake a detailed survey of the general waste dump area with a view to improving segregation and storage of hazardous material, maximising recycling and restricting access to scavenging.
- Review all sources of air pollution within the area and initiate mitigation measures (i.e., process changes, fuel changes etc.), as appropriate.
- Undertake Phase I and Phase II assessment of all abandoned facilities.

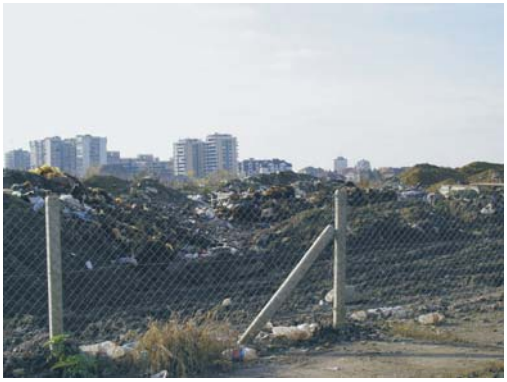
Sabac Landfill

Key Environmental Issues

- Improper location, access control and leachate/landfill gas management
- Potential spontaneous combustion of waste
- Possible improper disposal of hazardous substances due to lack of control

Site description

Sabac's municipal landfill is located in a shallow depression formed between the Sava River flood barrier and a railway embankment on the city's perimeter. A residential area is nearby, as is the Sava River and a popular recreation area. The landfill was opened in 1992, following public complaints about the municipality's former landfill at Varna. The site occupies 17 hectares, nine of which have been restored to grassland.



Municipal landfill, Sabac

Overall site assessment

Each day, the municipal landfill accepts approximately 200 m^3 of domestic waste that is generated by 25,000 households (60,000-70,000 people). The site also accepts medical and slaughterhouse waste. Although there is a security post outside the landfill, no formal system exists for authorizing admission. There are also no fees for use of the landfill. Cardboard, paper, steel and non-ferrous metals are separated for recycling. Hazardous wastes are reportedly retained at local industrial facilities. The site has no basal containment, landfill gas or leachate controls. Vermin and pests are minimised by the daily covering of waste with a soil layer, and sodium hydroxide solution is sprayed in the summer months.

Site Recommendations

Priority action

- Establish a system for recording the vehicles (e.g., driver name, vehicle number) entering the landfill to assert some control over misuse of the landfill.
- Implement measures for proper handling and disposal of medical and slaughterhouse waste and train staff accordingly.

Medium to long-term actions

- Conduct a full assessment of leachate and landfill gas, and monitor groundwater in the area.
- Construct a new regional landfill consistent with the National Waste Management Strategy.
- Launch waste prevention and recycling activities.

3.5.2 Institutional Capacity to Protect the Environment

The Executive Board of the municipality of Sabac has principal responsibility for environmental protection. At present, a one-person environmental protection unit in the city's Department for Housing, Communal Services & Environmental Protection implements environmental protection policies and programs. In addition, the city has 26 communal inspectors (13 are assistants) with authority over air and noise violations in small enterprises.

In 1985 and 1990, municipal officials developed five-year environmental plans that contained environmental projects. Today, plans are underway to begin a **LEAP** process. Priority environmental concerns include untreated municipal and industrial wastewater; improperly sited landfills; industrial pollution from the Zorka complex (air, water and soil pollution); and medical and slaughterhouse waste. The LEAP will be linked to a new urban plan, which will define specific zones for industrial development.

Municipal authorities describe **air pollution** as one of Sabac's most pressing environmental problems. The Public Health Institute monitors air quality from three stationary locations, one of which belongs to the municipality. The municipality also has a fully equipped mobile monitoring station. It is not uncommon for sulphur dioxide and other applicable thresholds to be exceeded. Local authorities, however, do not have the capacity to monitor particulate matter. In addition, the local public health effects of air pollution have not been studied recently and consequently are not well understood. A study conducted by the Institute for Public Health between 1975 and 1985, however, found an increased incidence of asthma and respiratory diseases among children during full operations of the Zorka chemical complex. Childhood asthma levels, though not currently an issue of concern, were previously five times the rate of surrounding communities. Local authorities cited these findings as relevant to discussions of whether to permit future increases in production at the Zorka chemical complex. Automobile traffic and home heating are additional sources of air pollution. One third of the population uses coal for heating. The municipality intends to switch its district heating from heating oil to gas and to develop an energy efficiency plan.

The communal enterprise collects **solid waste** from the entire city and six settlements—approximately 25,000 households. The municipal landfill receives 18,000-20,000 tonnes of waste per year and, at this rate, has capacity sufficient for only 5-7 more years of deposits. The old municipal landfill is located 10 kilometers from the city. Although it is fenced off and in a poor condition, local communities continue to use it. The area also reportedly has numerous illegal landfills. Medical waste is partly incinerated (in a furnace that has old filters and pollutes the air) and partly sterilized. The Public Health Institute has made efforts to prevent mixing of medical waste with communal waste.

Several plans are underway to solve the municipality's waste management problem. A strategy for communal waste management is being developed, and a Belgrade company is exploring the feasibility of rehabilitating the landfill. In addition, the Regional Environment Center, with Japanese government assistance, has studied waste management models and possible locations for a regional sanitary landfill for six municipalities. A site at Sremska Mitrovica has been identified as a feasible location and a design has been completed, but funding has not yet been obtained. Other projects are examining regional strategies for the collection of medical waste and the safe treatment of slaughterhouse waste. In June 2003, the municipality launched efforts to separate and recycle certain types of waste such as batteries and copper.

Sabac does not currently have a wastewater treatment plant. For now, only urban areas are connected to the sewage system, and **wastewater** is being discharged directly into the Sava River. Industries are not pretreating their waste according to permit requirements, which has inspired the municipality to prepare a database of wastewater polluters. (The Swedish Red Cross is supporting a plan to extend the cadastre to waste and air polluters as well.) A 1998 plan for the construction of a wastewater treatment plant plan identified a location and the need for approximately 15 million Euros for the project's first phase.

Sabac's **drinking water** comes from groundwater wells and, according to municipal authorities, is considered to be of good quality. The municipal water company monitors drinking water quality by sampling raw and tap water. The Public Health Institute also assesses drinking water quality independently. Concentrations of manganese in the raw water occasionally exceed national maximum allowable concentrations, but these levels are generally reduced with treatment.

The urban area's inhabitants are all connected to Sabac's 120-kilometer **water supply network**. The network is gradually expanding to include suburban areas and surrounding villages. The municipal water company reportedly collects 80% of its bills. While this rate is higher than in many other municipalities, the low price for drinking water of 10.20 dinars/m^3 (approximately .15 Euros) is insufficient to cover maintenance and investment costs. As a result, the system is in poor condition and loses an estimated 40% of its water. Lacking funds, the municipal water company currently can only afford to fix pipes when streets are being repaired. In 2003, for example, only 6% of the system was repaired. Despite these difficulties, the local authorities do not have a strategy for conserving water use. Water meters have been installed, but the majority of the equipment is in poor condition.

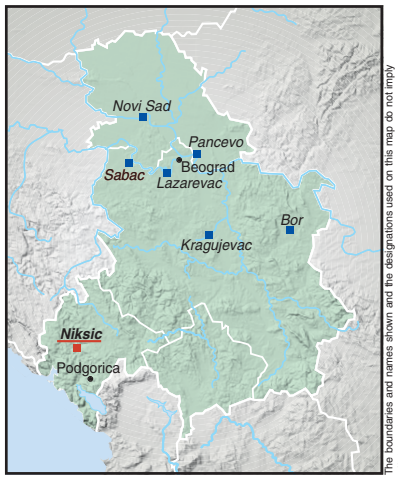
Sabac's **NGO community** is well organized and dynamic. One NGO, for example, filed legal claims to enforce air emission limits and in 2001 won a judgment against the Zorka complex. In general, the NGO community appears to have good communication with municipal authorities and adequate access to environmental data.

Recommendations

- The municipality should initiate the LEAP process promptly in order to establish local environmental management priorities and to gather support for much-needed environmental projects.
- The creation of a municipal environment department would strengthen the municipality's capacity to manage identified priority projects and to coordinate environmental action on the local level.
- Efforts to address the municipality's severe solid waste management problems should continue to be regarded as an urgent priority. A sanitary landfill should be constructed. The old municipal landfill and illegal landfills should be monitored and remediated to reduce unacceptable risks to human health and the environment.
- The water supply company should develop a low-cost strategy for the promotion of water conservation in order to reduce supply losses and lower wastewater volumes.
- The construction of a wastewater treatment plant deserves the support of the state government and the international community.
- Enforcement measures should be taken against industrial facilities that fail to pre-treat wastewater in compliance with their permits. If necessary, voluntary compliance measures between site owners and enforcement authorities could be considered.

3.6 Niksic

With a population of approximately 65,000, Niksic is the second largest municipality in the Republic of Montenegro, after the capital Podgorica. The city is located in the western part of the republic, approximately 630 meters about sea level, on a plateau between the coast and the mountains. The town's economy is based on industry (steel mill, saw mill and hydroelectric plant) and agriculture as well as its commercial centre. National authorities generally regard Niksic as one of Montenegro's potential environmental hot spots.



3.6.1 Site Assessment

Niksic Steelworks[54]

Key Environmental Issues

- Environmental responsibilities for the complex's shared facilities is not clearly delineated
- Environmental issues not addressed adequately during closure or privatization of units
- Indoor air pollution in steel plant due to poor ventilation systems
- Wastewater discharge and landfill runoff polluting the river
- Hazardous wastes entering the facility as scrap

Site description

Niksic Steelworks is a specialty steel manufacturing plant. Raw steel is produced using two electric arc furnaces. Prior to 1990, the maximum steel production was approximately 300,000 tonnes per annum. Today, the factory produces some 60,000 tonnes annually. Employment at the plant has reportedly dropped from approximately 7,300 to 3,200. The steelworks include a steel melting shop; bloom rolling mill; combined bar, rod and section mill; medium and light section mill, light sections; forging mill and a drawing plant.

Process cooling water is drawn from a local reservoir Liverovici. The steelworks has a lignite-burning thermal power plant with four boilers that supply steam and three megawatts of electricity. Furnaces in the rolling mill reportedly burn heavy heating oil.

With production levels well below total capacity, the company has shifted towards the manufacture of simple, low-quality building products such as reinforcing bar. The plant has suffered from debt, low domestic demand, limited access to the world market, minimal maintenance and virtually no investment in modernization. Like its counterpart in Sartid, Serbia, the plant is heavily state subsidized.

The privatization of the steelworks, or parts of it has been discussed with potential international buyers. The Montenegrin government is in the process of clarifying the framework for apportioning liabilities when its industrial facilities are privatized.

Overall site assessment

The site assessment team visited Niksic on 10 November 2003.

The Niksic Steelworks produces acidic **wastewater** from its foundry and casting facilities and boiler water from the power plant. Reportedly, all wastewaters, contaminated chemically, mechanically and thermally are treated in the system for wastewater treatment, recycled and discharged into the Bistrica River and the Gracanica River, which drain toward Lake Skadar and the Adriatic Sea. The assessment mission could not confirm the operational level of the wastewater treatment system. Aluminum and ferric sulphates are added to the influent to encourage flocculation. Sanitary wastewater is collected separately and discharged into the municipal sewerage system.

The plant's electric arc furnaces, which date back to the 1950's and 1970's, are a major source of particulate matter and heavy metal **air emissions**. Approximately 1,000 tonnes of particulate matter is emitted annually. When the plant is in full production, however, the volume of particulate matter emissions is more than twice as high. In the 1980's, bag filters were installed to reduce particulate matter emissions. The filters, however, have not been functioning during the past three years due to a lack of spare parts and inadequate maintenance. The estimated cost of installing new bag filters is 2.5 million Euros. The steelworks currently does not have funding to purchase the equipment.

The power plant has four boilers and generates steam and electricity (80 megawatt capacity). Each year, the plant burns 30,000 tonnes of lignite with 0.1% sulphur content and generates approximately 5,000 tonnes of particulate matter. The steelworks has estimated that a venture scrubber could reduce particulate matter emissions from 1,400 mg/m^3 to 150 mg/m^3 at a cost of 450 000 Euros.

Indoor air pollution at steelworks, Niksic

The steelworks also has a number of more minor emission sources. A smaller electric arc furnace emits particulate matter. Preheat furnaces for steel rolling burn oil and emit sulphur dioxide and particulate matter. The plant also receives periodic complaints from residents regarding dust emissions, especially during non-windy periods. According to information provided by the MEPPP, ambient air quality measurements in 2002 found monthly mean smoke (PM_5) concentrations between 12 and 69 μg/m^3, sometimes in breach of the 60 μg/m^3 24-hour limit value.

The plant is storing its **chemicals and acids** in tanks without secondary containment, adequate signage, information or emergency response facilities. This arrangement does not meet environmental management requirements and poses unnecessary risks to safety and the environment.

The plant generates various forms of **solid waste**, including PCB capacitors, explosives and car batteries, all of which are stored on site. Coal ash (reportedly 10,000 tonnes per annum), slag, scrap steel, sludge from the wastewater treatment plant, bag filter dust and casting sand (reportedly 9,100 tonnes per annum) are deposited in the steelworks landfill, which is located three kilometers from the main facility. In addition, the facility receives hazardous waste-containing scrap, including car batteries, asbestos insulation products, radioactive materials, PCB-contaminated equipment, car batteries and gas cylinders. Although personnel at the facility segregate these hazardous wastes when they are identified, the site does not have a hazardous waste storage or disposal facility.

Improper storage of used batteis at steelworks, Niksic


Scrap metal storage at steelworks, Niksic

An Austrian company is recycling scrap metal from the landfill under a lease. The landfill, which has been operational for 50 years, covers approximately 12 hectares and is 30 meters deep. The landfill was sited in a natural depression on the side of the Gracanica River. Leachate and runoff from the landfill is likely to be contaminating the river. The river is dry during the summer months. When it is flowing, the river enters a swallow hole near the landfill and emerges as a spring in Niksic town. Although it was reported that none of the transformers at the site contained PCB's, site personnel indicated that the replacement dielectric fluid was pyralene (a trade name for PCB manufactured by Prodelec). The assessment team confirmed that the capacitors at the site contained PCBs. No inventory of electrical equipment, specifications or test results were made available for review. According to plant management, however, all used and replaced PCB capacitors are safely stored in a controlled bunker.

Although a site-wide visual survey of potential asbestos-containing material (ACM) was not performed, the site walk-over indicated that potential ACM was primarily restricted to cement sheet cladding on ancillary buildings. It was reported that an ACM insulation replacement programme had been undertaken. No documentation, however, was available for review, nor was the asbestos waste disposal site known.

Site Recommendations

Priority action

- Review the complex's overall environmental resources and the linkages among its various industrial units in order to delineate the environmental responsibilities and liabilities associated with each of the units.
- Ensure that responsibility for environmental liabilities is explicitly addressed during the privatisation/closure process.
- Establish a system to control the unauthorised entry of hazardous waste-containing scrap, and establish a system to store and segregate hazardous material arriving at the site.
- Improve indoor air quality by repairing the local exhaust ventilation systems.

Medium-term action

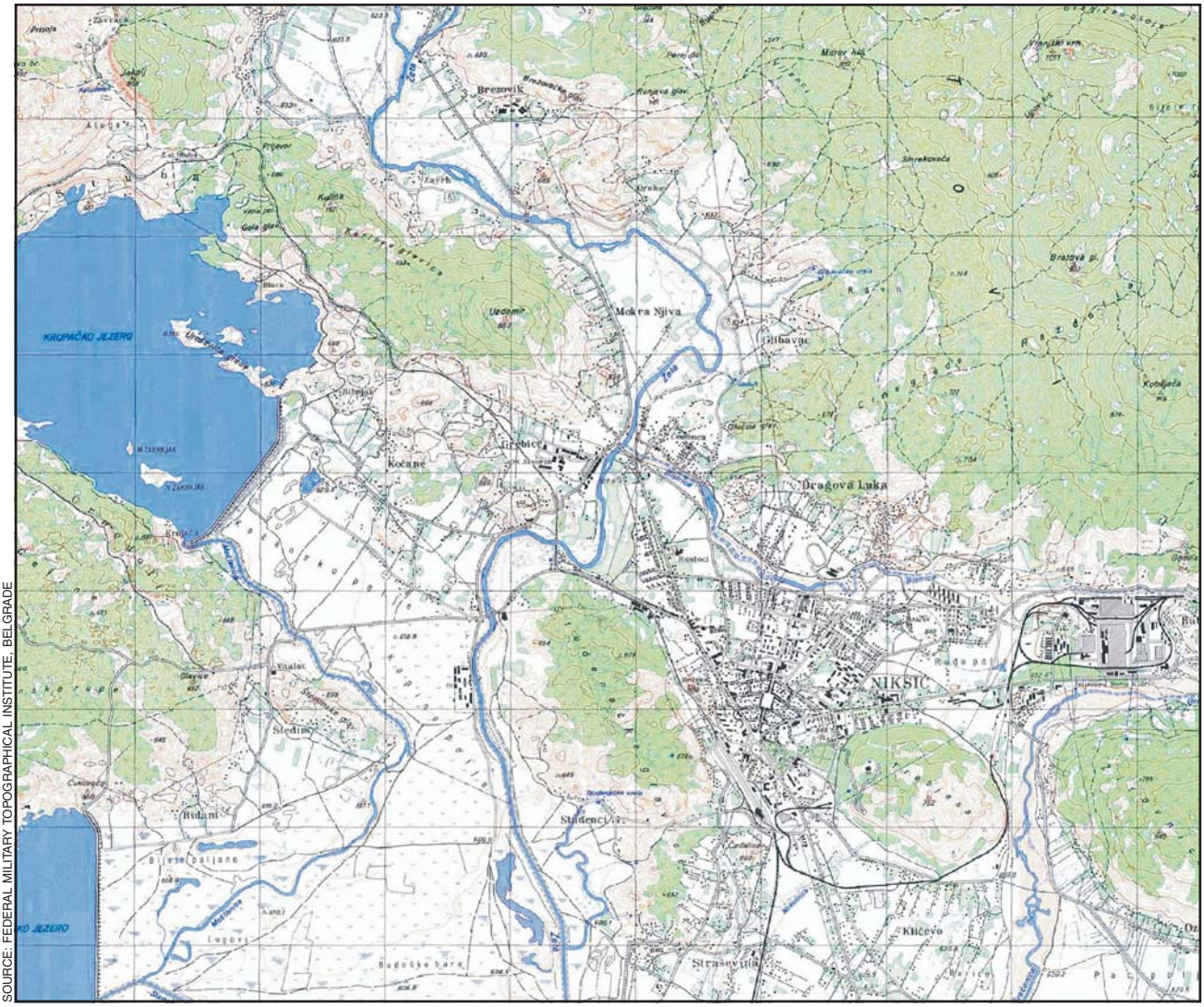
- Repair the bag filters to maximise the capture of particulate matter.
- Ensure that the wastewater treatment plant is fully operational and meets permit requirements.

3.6.2 Institutional Capacity to Protect the Environment

The municipality is responsible for waste management, water supply and sanitation, parks and greenery. The municipality's **Environmental Protection Department** was established in 1992 and today consists of nine staff. The Department's major activities include measuring biodiversity in protected areas, developing environmental education and environmental campaigns and analyzing the MEPPP's annual reports.

The municipality is currently planning to develop a LEAP, but has not yet commenced the process. The city's key environmental priorities are industrial pollution, illegal solid waste dumps, drinking water shortages during summer months, and untreated wastewater. A general lack of environmental awareness in the community is regarded as a great impediment to needed environmental improvements.

The MEPPP **monitors** air, soil, river and surface water quality and radioactivity and has complete responsibility for environmental **inspections and enforcement**. The Ministry provides municipalities with annual reports containing monitoring data, but municipal officials report that communication with the MEPPP is intermittent. As a result, the municipality often lacks basic information on the current state of the local environment. Municipal authorities also believe that the MEPPP's four inspectors are too few and that the republic should provide more local enforcement authority. The republic's new law on local self government has not decentralized environmental inspection powers. Training and provision of additional resources to the MEPPP would improve the Ministry's capacities to monitor and share information as well as inspect, and enforce the law.



SOURCE: FEDERAL MILITARY TOPOGRAPHICAL INSTITUTE, BELGRADE

Niksic and its surroundings

Niksic has an active **NGO community**. The major local NGOs are working to improve the city's environment by organizing educational and informational activities for citizens. Water and wastewater are high priority issues, as is phenol pollution from the ironworks, which has reportedly caused severe **soil contamination** and threatens to contaminate the groundwater supply. In June 2003, the municipality adopted a declaration of cooperation with the NGO community and will soon support NGO activities.

The municipal public utility collects and disposes of approximately 50% of the **solid waste** generated by the city's households. The waste is deposited at a municipal landfill on the bank of the Draconic River. Medical waste is partly incinerated and partly buried in the landfill. In addition to the municipal landfill, the city estimates that about 30 illegal dumpsites exist in and around Niksic. Although no data were available about the content of these sites or the risks they are posing, many are known to be burning. The municipality has developed a cadastre of illegal dumpsites that identifies the worst hot spots. Many are located on riverbanks or in riverbeds.

The municipality has recently selected a site for a new temporary landfill and is developing a feasibility study for a sanitary landfill. The project has been developed in cooperation with the MEPPP. The temporary landfill site is located seven kilometer from Niksic and reportedly meets all environmental requirements. Construction began on the site in September 2003, but the municipality lacks funding to complete the project and does not have proper equipment to manage waste. A MEPPP project to create regional landfills, which is supported by the World Bank and the European Agency for Reconstruction, does not yet cover the Niksic area.

Niksic's **drinking water** source is located 10 kilometers upstream of the city and is not influenced by industrial pollution. According to municipal authorities, the quality of the drinking water is very good and the raw water does not need to be filtered. The municipality, however, has experienced supply shortages during summer months, a problem compounded by high per capita water consumption and a crumbling 40-kilometer network that loses high volumes of water. Deepening the problem are the city's low tariffs and collection rates. At present, only 20-25% of industrial users and 60% of citizens pay their bills. In a region in which only 25% are actively employed, however, the prospects of increasing revenues are not promising. The municipality has not initiated any programmes to reduce water consumption.

Approximately 70% of Niksic's population is connected to the municipal sewage system. The municipality's **wastewater** is untreated and is discharged into the Zeta River, which flows to the Adriatic Sea. The city hospital's wastewater is not connected to the sewage network and flows into a septic tank. During rainy periods, the wastewater often washes out. Soil and groundwater in the area is contaminated with fecal matter, raising the potential for the cross-contamination of drinking water supplies and the spread of waterborne diseases.

All industries are obliged to pre-treat their wastewater. Only the ironworks, however, partly pre-treats its wastewater. The local brewery was described as not meeting any applicable wastewater standards and as being the city's biggest wastewater polluter. The brewery's wastewaters are discharged directly into the Bistrica River.

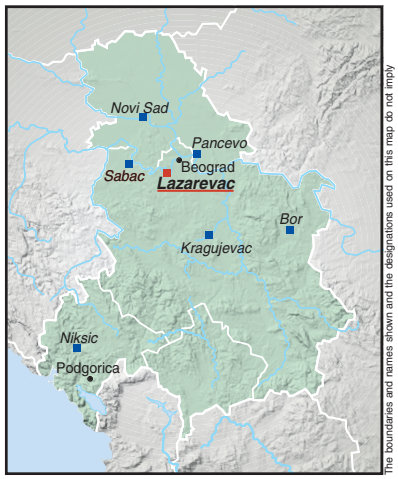
A wastewater treatment plant that was operational until 1989 is no longer functioning. A project for reconstruction and remediation of the plant was prepared in 1991, but the project was never funded. In 2000, the project was updated to increase the plant's capacity. Although one quarter of the work was completed, the project eventually stalled. According to one local source, wastewater pollution from Niksic is affecting all of southern Montenegro.

Recommendations

- Illegal landfills should be closed as quickly as possible and viable alternatives developed. The public health risks posed by illegal landfills should be investigated and mitigated.
- Reconstruction of the municipal wastewater treatment plant should be assigned a high priority.
- Industrial wastewater pretreatment standards should be enforced reasonably to reduce effluent discharges into the river.
- The feasibility and cost of connecting the hospital to the municipal sewage system should be studied and a fundable project developed.
- Investments in the water system are urgently needed to cover operation and maintenance costs, to improve sanitary conditions and to safeguard drinking water quality. In order to alleviate periodic water shortages, the municipality should initiate a campaign to promote wise water use. Greater efforts are needed to improve the water and sewage tariff collection rate if the system is to be sustainable financially and technically.
- The municipality should consider initiating a LEAP process to establish local environmental management priorities and to gather support for much-needed environmental projects.
- Additional municipal authority to conduct environmental inspections would improve enforcement and reduce pollution.
- The flow of monitoring data from the MEPPP to the municipality should be improved so that local decision makers and the public will be aware of air, soil and water quality problems. This implies the strengthening of the MEPPP monitoring and inspection capacities through training and the provision of additional resources.
- The NGO community should be fully supported in its important efforts to raise public awareness of local environmental issues.

3.7 Lazarevac

The municipality of Lazarevac, which is located approximately 40 kilometers south-southwest of Belgrade, has a total population of 62,000, of which 22,000 live in the city. Kolubara, which is located in the municipality of Lazeravac, has a number of interlinked industrial operations, including a plant for the maintenance, overhaul and production of mining equipment; a facility for the production of conveyor belts; a lignite processing facility, a brick factory, a power plant and a civil engineering company. Kolubara Basin has been a source of lignite since 1956. The Basin includes four open cast lignite quarries that produce a total of 28 million tonnes of lignite and 60 million m^3 of overburden per annum.



3.7.1 Site Assessments

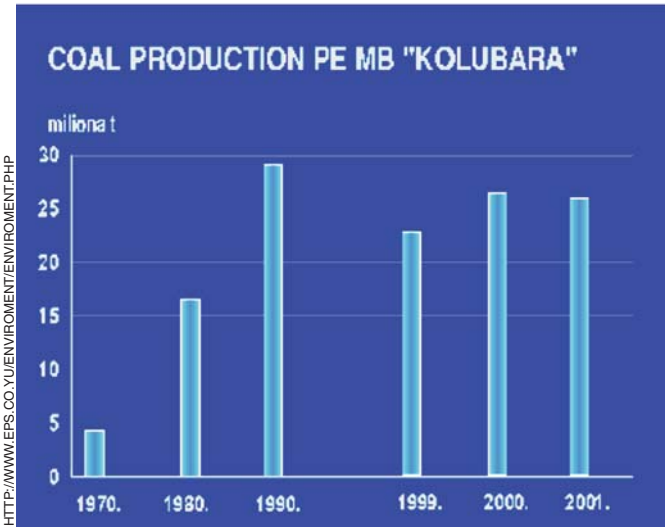
Kolubara Coal Processing Unit[55]

Key Environmental Issues

- Poorly treated wastewater effluent from coal washing units
- Air pollution from lignite processing and coal transport

Site description

The Kolubara Coal Processing Plant has a capacity of 855,000 tones of dried lignite per annum. The facility includes a utility plant that burns raw lignite (with a crude oil start-up) to produce steam. The steam is used for lignite processing, for the gas concrete plant and for district heating. Steam-dried lignite has improved combustion characteristics.



SOURCE: ELECTRIC POWER INDUSTRY OF SERBIA, HTTP://WWW.EPS.CO.YU/ENVIROMENT/ENVIROMENT.PHP

Figure 1. Coal production levels in Kolubara

Lignite is in high demand in Serbia. As a result, the Kolubara coal unit is fully operational. The majority of the lignite produced at the plant, approximately 25 million tonnes, is processed and used to fuel three power stations. In 2000, over half the lignite used by the power plants fuelled the production of electricity. The remainder of the lignite is sold for residential use. In the absence of a major economic recovery in the short term, available coal reserves in Serbia can be expected to be the prime source for meeting energy needs. The Kolubara unit can, therefore, be expected to be fully operational in the foreseeable future.

The company's financial situation is less certain. Due to the country's general economic difficulties, it is likely that the Serbian government will need

to continue to subsidize consumer energy purchasing without a strong hope of cost recovery. Even while working at full capacity, the Kolubara processing unit is likely to face cash flow difficulties that may hinder its ability to plan and implement environmental management measures. The company's capital shortage also prevents it from upgrading to less polluting lignite processing technologies.

The government is expected to adopt new energy legislation in 2004 that will open the country's energy markets and allow regulated privatisation of the industry.

Overall site assessment

The assessment mission visited the facilities on 11 November 2003.

The processing plant's **wastewater treatment unit** includes neutralization and settling basins, an activated sludge unit and a clarifloculator. The unit's effluent is discharged, along with effluent from the power plant, into the Kolubara River, which is already highly burdened and in excess of applicable water quality limits. Coal washing effluents are typically very high in suspended solids, dissolved organics, relatively low in biological oxygen demand, high in phenolics and contain a range of heavy metals. The current treatment scheme reduces suspended solids, but is not designed to address dissolved organics, and removal of phenol is incidental.

Wastewater from coal processing plant, Kolubara

Wastewater settling pond, coal processing plant, Kolubara

The wastewater treatment facility is also not entirely operational. Its sedimentation basin has not been de-silted for decades and has effectively become a constructed wetland full of reeds. Air is not injected into the water due to complaints about foam forming in the effluent. The final effluent, therefore, is very colored and still has very high levels of dissolved organics.

The plant's coal-drying process produces **air emissions**—including phenol compounds, odors, particulate matter, SO_2 and NO_x—that are a major source of complaints from the surrounding community. Phenol, SO_2,

NO_x and particulate matter are monitored annually. Although phenol, SO_2 and NO_x concentrations are ordinarily within applicable limits, particulate matter concentrations typically exceed the limit value. In addition, approximately 200,000 railroad cars (and 400,000 trucks) annually transport the plant's brown coal. The train engines burn lignite fuel and cause severe localized air pollution from particulate matter, unburned material, and SO_2.

Steam-powered locomotive as emission source at coal processing plant, Kolubara

Ambient air quality monitoring data collected in 2002 revealed major particulate matter and soot problems. The 24-hour concentration limit for particulate matter was breached during 191 days, and the soot limit was breached during 80 days. NO_x concentrations also breached the limit value occasionally, and high concentrations of phenol were measured in the industrial area. Only SO_2 concentrations were consistently within the 24-hour limit values.[56]

Site Recommendations

Priority action

- Make the various units in the wastewater treatment facility, including monitoring systems, fully operational.

Medium-term action

- Review options for minimising air pollution from the coal-cleaning unit, including process change and end-of-pipe technologies.

Kolubara Power Plant (TPP Kolubara)

Key Environmental Issues

- Air and possibly groundwater pollution from fly ash storage and dried lignite storage
- Groundwater pollution from fuel oil storage and spillage

Site description

TPP "Kolubara" is located at the edge of Kolubara coal basin in the village Veliki Crljeni. The total installed capacity of its five units amounts to 245 MW. The plant's average annual power generation is about 500 million kWh, which is supplied to the power system at 110 kV. The first generating block at Kolubara was commissioned in October 1956. The plant now has five generating blocks, each of which is fitted with an electrostatic precipitator.

Overall site assessment

The assessment mission visited the facilities on 11 November 2003.

The plant uses heating oil as an auxiliary fuel and has an induced draft cooling system. No biocide programme, however, has been initiated.

It was reported that the dried lignite stockpile often self-ignites causing emissions of dust and smoke.

Ash from the boilers is mixed with water and transported hydraulically via a pipeline to a fly ash landfill. The **fly ash landfill** is located approximately three kilometers from the main power plant. The landfill occupies approximately 20 hectares and has a depth of approximately 12m (approximate volume of 2.4 million m^3). During the winter months the fly ash landfill is part-covered with water. Excess water is clarified and recycled. During summer months, however, the landfill dries out and fugitive dust is a source of complaints from a neighbouring village. An old fly ash landfill has been restored with 25 centimeters of subsoil and has been revegetated with e.g. grass, wheat.

Fly ash disposal site, Kolubara power plant

Air emissions are monitored at least annually. Ambient air is sampled and analysed from 19 monitoring locations in the Kolubara region, including one measuring point within the site and one located 5.5 km southeast of the plant.

Stacks at power plant, Kolubara

Lignite from the Kolubara Basin produces SO_2 concentrations in the range of 2,300 and 2,700 mg/m^3 and NO_x concentrations between 70 and 190 mg/m^3. The plant's electrostatic precipitators reportedly have a particulate removal efficiency of between 90%-99%. NO_x emissions are within the permitted limits. Dust from the stack and fly ash landfill, however, exceeds permitted levels.

Although a site-wide visual survey of potential **asbestos containing material** (ACM) was not performed, the limited site walk-over indicated that potential ACM was primarily restricted to cement sheet cladding on ancillary buildings. An ACM insulation replacement programme is said to have begun, but no documentation was available for review, nor was the asbestos waste disposal site known.

Wastewater discharge in housing area, Kolubara, Lazarevac

TPP Kolubara generates fly ash waste; waste oils, which are recycled; contaminated soil, which is deposited in the fly ash landfill; and general waste. It was reported that the power plant does not generate hazardous wastes, but waste management records were not made available for review.

Anecdotal evidence indicates that the soil and groundwater at the site have been subject to impacts from oil spills (accidental and conflict-related), fly ash water (suspended solids and heavy metals) and widespread particulate deposition.

Site Recommendations

Priority actions

- Take preventive measures to avoid spontaneous fires at the dried lignite storage.

Medium-term action

- Monitor the operation of the fly ash deposition area. Create grass cover to minimize re-suspension, and monitor nearby groundwater to detect contaminant migration.
- Investigate the possible reuse of fly ash as a building construction material.
- Monitor groundwater around the fuel storage area to identify any ground water contamination.
- Reduce SO_2 and particulate matter emissions.

3.7.2 Institutional Capacity to Protect the Environment

In 2000-2001, the municipality formed an **Environment Committee** within its municipal Executive Board. In June 2003, the municipality adopted an eco-tax on enterprises and institutions. The eco-tax is expected to provide 300,000 Euros in revenue for the coming year. These funds will be dedicated to environmental projects and will be supplemented by payments from Kolubara's industrial facilities for use of the municipality's land and resources.

The municipality, working in cooperation with the national environmental authorities, has begun a **LEAP** process. Committees have been formed to determine priorities, and it is expected that the process will conclude in late 2004. Priority issues are to be addressed as soon as possible.

Seventy percent of the municipality's **solid waste** is collected and disposed in a landfill located on the site of a former mining pit 20 kilometers from the city. Although it has been in use for 20 years, local officials consider the landfill to be temporary. The waste mixture includes communal, medical and industrial, though not hazardous, waste. The landfill is not controlled or sanitary, and it is unclear how protective the pits are of soil and groundwater. The landfill is sectioned, however, and has recently been consolidated to establish better control. According to local authorities, the landfill's fees are substantially insufficient to meet costs, so the municipality subsidizes the enterprise. In 2004, a portion of the eco-tax funds will be allocated for rehabilitation of the landfill. Ultimately, the municipality anticipates creating a regional landfill consistent with the republic's National Strategy on Waste Management.

According to local officials, the principle source of **air emissions** is the local thermal electric power plant and processor in Vratse, which produces a great deal of dust. The municipality hopes to reduce emissions by connecting more homes directly to the thermo-power plant for their electricity supply. Traffic is also an increasing problem.

Since May 2003, the municipality, in cooperation with national authorities has sited two **air quality monitoring** stations, including one at the local elementary school, that are measuring sulphur dioxide and dust concentrations. These join other stations located outside of the city, including in Kolubara. Air quality is adversely affected by high pressure in the city's microclimate. Local medical officials indicated that in recent years there has been evidence of increased incidences of chronic diseases, including elevated levels of bronchial asthma among children and adults.

As is true throughout Serbia & Montenegro, municipal **inspectors** in Lazeravac have limited authority and mostly enforce air and noise violations. Four communal inspectors perform much of the environmental inspection function. An important focus is ensuring that construction projects abide permit limits. The municipality is anticipating that the new law on local self-government will shift more power to local environmental inspectors.

According to municipal authorities, Lazeravac's **drinking water** is of satisfactory quality and is being delivered to the entire municipality. Local officials, however, are concerned about the adequacy of the supply and the system's overall sustainability. The municipality needs a total of 16 drinking water wells but only ten have been completed due to lack of funding. Consideration is being given to extending the first source or developing a regional supply. At the same time, there is some concern that more expansive digging at the mine, which is permitted under a national spatial plan, would jeopardize the integrity of drinking water wells protected under local plans. The quality of drinking water is already a concern in some of the municipality's outlying villages, where unauthorized wells seem to be leading to increased incidences of illness.

The **drinking water** system's financial picture is not positive. The municipal enterprise is collecting 70% of payments due while the network is sustaining enormous losses. During 2003, the municipality initiated a programme to sanction consumers using water in excess of an established limit, but the measure proved to

be unenforceable. Instead, communal inspectors were forced to shut down the city's supply during certain hours of the day. A separate effort to impose block prices and use water meters was also cancelled. The municipality has not yet attempted to promote wise water use through educational campaigns.

Lazeravac's **wastewater** is considered a priority. Only the urban area of the municipality (where there is no industry) is connected to the sewer system. Communal wastewater is discharged into the Kolubara River, which leads to the Sava River and the Danube River. A project for a wastewater treatment plant has been designed, but no funding has been obtained.

Lazeravac's **NGO community** is very active, working on a wide range of issues, including clean-up and monitoring of illegal landfills, recycling, fishing, mountaineering, scouting, education, planting of trees and forest protection. The NGOs generally agree on the priority issues identified by municipal authorities. They wish to see the LEAP process proceed more rapidly and to receive stronger support from the local authorities for their activities.

Recommendations

- The LEAP process should be encouraged, and the implementation of identified priority actions should be supported by national authorities and international partners.
- The municipality, with the assistance of national authorities, should develop an alternative to the existing municipal landfill as soon as possible. In order to improve solid waste management in the short term, waste should be separated, hospital waste should be treated and containered, and hazardous waste should be safely stored until it can be moved to a secure hazardous waste landfill.
- The municipality should develop a comprehensive drinking water strategy to identify appropriate new sources and should investigate methods for establishing a financially sustainable management system that will increase revenues and reduce network losses. In the very short term, demand for water should be reduced through the promotion of water conservation.
- The municipality's plans to build a wastewater treatment plant should be considered a high priority deserving the full support of national authorities and international partners.

4. CONCLUSION AND GENERAL RECOMMENDATIONS

Serbia & Montenegro's transition phase entails many great challenges, but also presents opportunities for the country to address many of its chronic problems. In the area of environment it is clear that the solutions to a number of severe problems have, for too long, been deferred in favour of other priorities. In the industrial sector, particularly, the results of inaction are quite clear. Years of neglect have led to contaminated soil, polluted waters and reduced air quality. The cost has also been paid in worker safety, community quality of life and human health. Plainly, the environment can no longer wait.

The reorientation of Serbia & Montenegro's priorities has begun, and environment is moving up in the national agenda. Efforts to improve environmental legislation and harmonize it with EU legislation are under way. Environmental action plans to identify and implement priority action, on the local (LEAP) as well as national levels (NEAP), have been elaborated and priority actions initiated. And the capacities of environmental authorities have been strengthened by newly founded ministries, an Environmental Protection Agency in the Republic of Serbia and municipal environmental departments.

The country's pollution problems will not be remedied, however, until every citizen has been engaged. The international community has a strong partnership role to play in assisting Serbia & Montenegro. The principle responsibility, though, rests within the country. The environmental ministries and municipal environmental departments should continue to grow and strengthen. Just as importantly, environment should be integrated into all facets of government policy and life—whether in developing physical plans, trade and economic development strategies, or policies in sectors such as agriculture, transportation and energy. Stronger partnerships will be needed among republican, provincial, municipal, private and public actors. Environment can no longer be seen as a challenge to the few, but as the responsibility of the many.

Within the environmental sector, there will also need to be further evolution. Environmental policies will need to shift over time from emergency remediation and end-of-pipe solutions to least-cost prevention strategies. One-size-fits-all environmental standards can give way to site-specific, risk assessment-based threshold and target values. Enforcement measures can be combined with economic incentives, such as tax credits for environmental schemes, tradable permits, and pollution taxes. And national solutions can be brought into greater conformity with the requirements of international agreements and conventions as well as EU norms.

Since 1999, UNEP and its partners have worked to assess and remedy a number of Serbia & Montenegro's most urgent environmental problems. The UNEP Clean-Up Programme has achieved a great deal by remediating site-specific, conflict-related risks and by strengthening institutional capacity in several important areas. The projects taken on by UNEP with the available funding were implemented in a cost-effective manner and achieved their intended impact.

As a result, the conflict-related environmental problems in Kragujevac have been remediated. In Novi Sad the risks to drinking water resources have been controlled and reduced. In Bor, the conflict-related problems, in part addressed by the Programme, are minor compared to the area's considerable overall environmental burden. In Pancevo, which suffered the most, some conflict-related environmental problems persist, though they have been reduced. In view of this progress at the four sites, the report concludes that Kragujevac and Novi Sad should no longer be considered environmental "hot spots".

With Serbia & Montenegro's normalization of international relations following the restoration of democratic governance, the international community's environmental focus has logically shifted from conflict-related remediation to environmental protection and management in a wider development perspective. The UNEP Clean Up-Programme has also highlighted the extent to which chronic environmental problems, such as those found at the seven sites investigated in this assessment, are representative of a broader set of industrial pollution and institutional capacity challenges facing the entire country. Much work remains to be done.

This assessment set out to fulfill a number of objectives. In furtherance of the Clean-Up Programme´s handover to Serbian authorities, the Programme was reviewed and clear guidance has been provided to ensure that the remediation projects will continue to achieve their goals. In addition, chronic environmental problems have been identified at each of the seven industrial locations visited, and recommendations have been offered for addressing those problems (and similar problems elsewhere). The mission has also looked beyond the question of industrial pollution to examine local capacities to manage the environment. In the course of these investigations a number of general recommendations emerged regarding the industrial sector and municipal capacities to protect the environment.

General Recommendations

Industrial sector

- Industry should be encouraged to recognize that environmental costs are an integral business expense and that a clean business environment will enable greater innovation and competitiveness. Specifically, Serbia & Montenegro should immediately take steps to integrate environmental management systems and cleaner production technologies that will prevent pollution (e.g., by reducing toxic substances and waste, and more efficiently using energy and raw materials) and minimize mitigation expenses.

- The creation of national hazardous waste management facilities with properly trained expertise is an urgent priority. The improper management and storage of hazardous waste and chemicals is a priority problem at most industrial sites. One approach to creating this capacity may be to grant a concession to an international company that would establish a facility on a “user pay” basis and operate it for 10-15 years. The creation of a well-managed facility could attract the interest of waste producers throughout the region and provide a strong business opportunity, consistent with the waste prevention approach.

- As an interim measure, hazardous materials could be temporarily stored in secured, properly built, and appropriately identified sites. This would prevent the spread of contaminants and avoid more costly interventions in the future. Support from government and better coordination among factory units will be necessary to implement such measures.

- The capacities of national environmental authorities to systematically assess and prioritise environmental problems at sites that are contaminated or pose risks to health and the environment should be strengthened.

- Serbia & Montenegro should consider establishing a national “environment fund”. The fund could help to finance, e.g. the clean up of hot spots, including pre-privatization liabilities; the creation of national environmental infrastructure; tax breaks/subsidies that would stimulate environmental investments by industries; the use of clean technologies; local environmental services and consultancies; a national environmental clearinghouse for the exchange of environmental information and expertise; and capacity building in industry and government. The fund might collect contributions from privatised companies as well as revenues from fees, permits, fines and other sources.

- The level of cooperation between site owners and enforcement authorities appears to be positive. Mechanisms for voluntary compliance by industry should be provided. Risk-assessed site targets and realistic compliance dates should be established. Consideration should also be given to training site owners and inspectors in alternative dispute resolution methods so that a spirit of cooperation can coexist with the imposition of adequate enforcement measures and the rule of law.

- There is much that industry can do to improve environmental conditions within their factory premises—e.g., local clean ups, improving storage conditions, providing adequate signage, exploring opportunities for recycling, etc. Managers and relevant authorities taking ownership of industrial facilities should

identify environmental issues and, to the extent possible, begin implementing solutions as soon as possible using available local resources.

- Thorough health and safety audits should be performed at each industrial site. Remedial measures—e.g., protective equipment or ventilation, designation of hazardous areas, changes in work cycles—can be implemented with minimal additional investment.

- A national emergency response coordination centre should be established with the facilities and expertise needed to respond effectively to industrial accidents. The emergency response capacities of industrial units should be enhanced and networked with other industries as well as the national centre. This centre could be established as a private, subscription-based organisation.

- Environmental information need to be better managed within the industrial units and shared with stakeholders. A standardized approach to environmental information gathering and sharing would benefit all parties involved. For example, all major industrial units could prepare "Site Environment Information" files that would include: a location plan highlighting major environmental features; a site layout identifying environmental infrastructure; a process-flow diagram showing major polluting sources; an organogram delineating environmental responsibilities; environmental laws with which the facility should be in compliance (including the current compliance status); environmental monitoring records (including records of data submitted to the government); total amount of air pollutants emitted to the air, in addition to ambient air quality values; records of environmental permits/exemptions; and records of public complaints/enforcement actions.

- Serbia & Montenegro should assess its existing environmental capacities and those of its neighbors to determine whether it would profit from developing and promoting environmental industries (e.g., regional contaminated land treatment centres). The Czech Republic, for example, has benefited from creating environmental management technologies.

- Serbia & Montenegro has a great deal of redundancy in its industrial facilities. Large areas of land, buildings and transport links offer great potential for redevelopment and the creation of environmental benefits, such as cleaner production facilities, waste and recycling management sites or environmental remediation projects. For example, scrap steel and other materials on several industrial sites could be sold to raise start-up funds. Similarly, under-utilized waste management facilities, such as cement kilns and waste oil incinerators, could potentially offer business opportunities.

- To address the challenges of EU integration, Serbia & Montenegro should consider a number of steps, including establishing an environmental integration team with lead responsibility for harmonization; assessing all proposed projects for consistency with EU legislation; consulting other accession countries regarding best practices, incorporating sustainability concepts into national economic development plans; and developing a renewed public utility sector (i.e., power, water, waste) with employees retrained in modern technology and environmental management practices.

Local Institutional Capacities

- Existing laws are not sufficiently harmonized among sectors on the republican and municipal levels or between the republican and municipal levels. The environmental legal framework in Serbia and Montenegro should be completed and adapted with a focus on clarifying competences, strengthening compliance and enforcement and harmonization with EU norms. Pending environmental framework legislation in Serbia should be adopted as soon as possible.

- Recently revised laws on local self-government in Serbia & Montenegro, as well as Serbia's pending environmental framework law, offer important opportunities to increase municipal control over local

environmental problems and to strengthen cooperation that will enhance compliance and enforcement on the republican and local levels. In particular, it will be important to expand the powers, equipment and resources of local environmental inspectors and to provide them with sufficient training, so that they can directly enforce a broader spectrum of environmental laws and permits.

- Municipal landfills are generally not sanitary and are accepting improper forms of waste, such as hospital and industrial waste. Separation or treatment does not take place, and modernization is impeded by low tariff collection rates. In rural areas, waste collection is practically non-existent. Waste is burned and disposed of in illegal landfills/dump sites. At the same time, there is little awareness of the impact that any of these facilities are having on soil and groundwater quality. In line with the National Waste Management Strategy in Serbia, waste reduction and prevention strategies are urgently needed. The Strategy proposes different plans for collection, transport, treatment and disposal of controlled waste. It is important that waste separation, recycling, construction of sanitary landfills in regions/cities is undertaken. In addition, monitoring of existing landfills needs to be improved and tariffs need to be adjusted to reflect the real cost of providing service.

- Industrial and communal wastewater is, with very few exceptions, flowing untreated into nearby receiving waters. Industries are not generally adhering to applicable pre-treatment requirements. Investments in wastewater treatment facilities are urgently needed, and industries should be brought into compliance with applicable pre-treatment or treatment requirements.

- Municipal water supplies lack the ability to sustain themselves financially. Bills are unpaid and fees are often inadequate. Maintenance and upgrading of supply infrastructure is generally weak. As a result, large quantities of the supplies are lost in the distribution network. There are few efforts to promote wise water use or to avoid future costs by, e.g., reducing flows/capacity needs for future wastewater treatment plants. To the extent possible, pricing policies should be rationalized to cover operations and maintenance costs. Economic instruments should be introduced to reduce consumption, including the installation of meters and consumption-based billing. The relevant ministries should train utility managers in demand-side management strategies and launch a national campaign to build public support for water conservation.

- Serbia & Montenegro's municipalities are suffering from severe noxious emissions from old and often poorly maintained industrial technologies. There is a strong need for improved pollution monitoring in urban areas, particularly in and around industrial facilities.

- Municipalities lack accurate environmental information and, therefore, the ability to assess independently the risks to local health and the environment. Issues of information ownership further complicate the problem. Access to accurate information would hasten the work of all stakeholders involved in environmental management. This problem could, to some extent, be alleviated by better sharing of existing information among environmental stakeholders, a need that well-managed LEAP processes could help to address. In addition, it is important to ensure that the technical quality of monitoring in Serbia and Montenegro is improved, allowing comparisons with relevant international standards. The environment ministries in Serbia & Montenegro should lead the way toward more effective environmental information management and better vertical integration of information with municipalities, which are currently developing their own environmental information resources. The recent creation of Serbia's Environmental Protection Agency should improve the republic's capacities to manage environmental information.

- Public awareness is essential to building a broad constituency for environmental change. For example, municipalities facing water shortages and pollution from illegal landfills are, in most cases, not taking adequate steps to educate the public about water-saving methods and the hazards associated with improperly disposed waste. Municipal environment departments should be strongly supported in their efforts to build public awareness and promote sustainable consumption patterns. Each of the depart-

ments should strongly consider dedicating staff resources to media and public relations. The country's increasingly active NGO community can also play an essential role in awareness raising, promoting transparency, highlighting priority concerns of the public and catalyzing action on the local level.

- It is equally important that municipalities begin to develop public participation opportunities. Public participation fosters general awareness and interest in environmental matters while enabling consensus building in support of specific municipal initiatives.

ANNEX 1: REFERENCES AND BIBLIOGRAPHY

References

1. With the adoption of a new law on Ministries in February 2004, the Ministry of Science and Environmental Protection took over the tasks of the Ministry for Protection of Natural Resources and Environment.

2. *The Kosovo Conflict Consequences for the Environment and Human Settlements,* UNEP-UNCHS October 1999, and the subsequent *UNEP Balkan Task Force: Feasibility Study Environmental Hot Spots*, April 2000 laid the basis for the Programme. Reports are available at http://postconflict.unep.ch/.

3. See Annexes 3-4, UNEP Clean-Up Programme.

4. The samples were taken and analyzed by the Institute of Public Health - Belgrade and the Center for Eco-toxicological Research of Montenegro – Podgorica, respectively.

5. With the adoption of the new law on Ministries in early 2004, the Directorate of Forestry, previously under the Ministry for Protection of Natural Resources and Environment was taken over by the Ministry of Agriculture, Forestry and Water Management. http://www.ekoserb.sr.gov.yu/engl/index.php

6. Competencies in Environmental Protection Policy of Montenegro, MEPPP

7. Common Country Assessment for Serbia & Montenegro, UN, October 2003.

8. Serbia and Montenegro, Country Environmental Analysis, World Bank, 2003

9. For a summary of project activities, see Annex 4

10. *The Kosovo Conflict Consequences for the Environment and Human Settlements*, UNEP-UNCHS October 1999. Report is available at http://postconflict.unep.ch/ . In 1999-2000, post-conflict assessments were conducted by other parties, in particular by authorities of the Federal Republic of Yugoslavia, the FOCUS group (a humanitarian aid task force organized by Switzerland, the Russian Federation, Greece and Austria) and an expert team from the City of Amsterdam, the Netherlands. The assessments' findings were in general similar and complementary.

11. EDC Contamination Investigation Works at HIP PetroHemija – Pancevo, Federal Republic of Yugoslavia, Dekonta-Aquatest, UNEP Clean-Up Programme/UNOPS Report, 2001.

12. *UNEP Feasibility Study*, 2000.

13. *Delimitation of EDC Pollution and Evaluation of Remediation Techniques at HIP PetroHemija*, Final Report, Aquatest, UNEP Clean-Up Programme/UNOPS 2002.

14. *Operation of Groundwater Remediation System at HIP Petrohemija*, Final Report for Period January-November 2003, UNEP Clean-Up Programme/UNOPS Report, 2003.

15. *Feasibility Study of the Decontamination of Mercury Contaminated Soil and Risk Assessment Studies*, SDC, 2003.

16. Total petroleum hydrocarbon (TPH) concentration in sludge sample: 296,286 mg/kg. IPH-Belgrade, UNEP assessment mission sampling results, November 2003.

17. Measured CO concentrations were 798 mg/m^3 and 1,013 mg/m^3, compared to the limit value of 175 mg/m^3. Maximum particulate matter concentrations were 88 mg/m^3 and 1,500 mg/m^3 compared to the respective limit values of 5 mg/m^3 (natural gas) and 100 mg/m^3 (fuel oil). Report on emission measurements from the emitters at HIP Petrohemija, Pancevo, 2003.

18. See e.g. American Society for Testing and Materials (ASTM) Standards for Environmental Site Assessment.

19. For a summary of the project activities, see Annex 4.

20. *The Kosovo Conflict Consequences for the Environment and Human Settlements*, UNEP-UNCHS October 1999. Report is available at http://postconflict.unep.ch/.

21. NIS-RNP is currently constructing a 2.5 km long pipeline Ø 600 mm that, upon its completion in February 2004, will be used for discharging pre-treated rainwater (collected from storm/rain sewerage) from the oil separator's clarifier basin to the downstream end of the wastewater canal.

22. Sludge samples indicated concentrations of 32.5 mg/kg of mercury and 300,828 mg/kg of total petroleum hydrocarbons. IPH-Belgrade, UNEP assessment mission sampling results, November 2003.

23. NIS-RNP letter dated 19 November 2003.

24. For a summary of project activities, see Annex 4.

25. *The Kosovo Conflict Consequences for the Environment and Human Settlements*, UNEP-UNCHS October 1999. Report is available at http://postconflict.unep.ch/.

26. *The Kosovo Conflict Consequences for the Environment and Human Settlements*, UNEP-UNCHS October 1999, and UNEP Feasibility Study (April 2000). See also http://postconflict.unep.ch/ .

27. *UNEP Feasibility Study,* (April 2000).

28. Report on Sampling and Analysis Results of Water and Sediment from Canal in Pancevo Industrial Complex - Waste Characterization and Particle Size Distribution, IPH Belgrade 2001.

29. PA.13 – Remediation of the Wastewater Canal in Pancevo Industrial complex - Report on technology, review and selection, DHI Water & Environment, UNEP Clean-Up Programme/UNOPS, 2002.

30. Study on Wastewater Generation, Collection and Treatment in Pancevo Industrial Complex, UNEP Clean-Up Programme, 2002.

31. Laboratory report on monitoring the average concentration of contaminants in communal environmental media (12.5.2003), Institute of Public Health, Pancevo, 2003.

32. LEAP Pancevo Summary Report, 2004.

33. See also Annex 3.

34. The National Waste Management Strategy, including the program of harmonization with the EU, Republic of Serbia, MPNRE, 2003.

35. For a summary of project activities, see Annex 4.

36. "*The Kosovo Conflict Consequences for the Environment and Human Settlements*", UNEP-UNCHS October 1999. Report is available at http://postconflict.unep.ch/.

37. *UNEP Feasibility Study*, 2000

38. Extension of the NIS-RNS wastewater collector has been addressed through a European Bank of Reconstruction and Development (EBRD) soft loan to the City of Novi Sad. Construction works are to be completed in early 2004.

39. *Air Pollution in the Republic of Serbia 2000*, Ministry of Health and Environmental Protection, 2001.

40. For a summary of project activities, see Annex 4.

41. *The Kosovo Conflict Consequences for the Environment and Human Settlements*, UNEP-UNCHS October 1999. Report is available at http://postconflict.unep.ch/ .

42. Report on Air Quality Monitoring in Kragujevac for the year 2002 (in Serbian), MPNRE, 2003.

43. For a summary of project activities, see Annex 4.

44. *The Kosovo Conflict Consequences for the Environment and Human Settlements*, UNEP-UNCHS October 1999. Report is available at http://postconflict.unep.ch/ .

45. UNEP Balkan Task Force: *Feasibility Study Environmental Hot Spots*, April 2000.

46. Risk assessments are available at http://postconflict.unep.ch/ .

47. Figures provided by RTB Bor. Ref. RTB Bor official letter to UNEP/UNOPS, dated 27.9.2002.

48. See *Assessment of Environmental Monitoring Capacities in Bor*, UNEP, September 2002.

49. Risk assessments available at http://postconflict.unep.ch/

50. Bor LEAP document, 2003.

51. No clean-up activities have been implemented by UNEP in Sabac.

52. It was reported that initially the jarosite produced by the process contained 3-5% zinc by weight (plus 1% in the pore water), and 30-32% iron. Due to operational problems, however, the zinc concentration has increased to 10% (plus 4% in the pore water). The facility has undertaken a study to improve scrubber efficiency, which would reduce the soluble and insoluble zinc concentrations of the jarosite (0.5% total) and neutralise/solidfy the jarosite with hydrated lime.

53. See Air Monitoring Results for the Territory of Sabac Municipality During the period January-June 2003, (in Serbian) Institute of Public Health-Sabac, 2003.

54. No clean-up activities have been implemented by UNEP in Niksic.

55. No clean-up activities have been implemented by UNEP in Kolubara.

56. Report: *Investigation and Assessment of the Air Quality in the Area Impacted by Industry Complex "Kolubara prerada", Vreoci, for the period 1.06.2002 31.05.2003* (in Serbian), Mining Institute Belgrade, 2003.

Bibliography

Air Monitoring Results for the Territory of Sabac Municipality During the period January June 2003, (in Serbian) Institute of Public Health-Sabac, 2003

Air Pollution in the Republic of Serbia 2000, Ministry of Health and Environmental Protection, 2001

Assessment of Environmental Monitoring Capacities in Bor, UNEP, September 2002.

Bor LEAP document, 2003

Competencies in Environmental Protection Policy of Montenegro, MEPPP

EDC Contamination Investigation Works at HIP PetroHemija – Pancevo, Federal Republic of Yugoslavia, Dekonta-Aquatest, UNEP Clean-Up Programme/UNOPS Report, 2001.

Feasibility study of the Decontamination of Mercury Contaminated Soil and Risk Assessment Studies, SDC, 2003

Laboratory report on monitoring the average concentration of contaminants in communal environmental media (12.5.2003), Institute of Public Health, Pancevo, 2003. (in Serbian)

LEAP Pancevo. Summary Report, 2004

NIS-RNP letter dated 19 November 2003.

PA.13 – Remediation of the Wastewater Canal in Pancevo Industrial complex Report on technology, review and selection, DHI Water & Environment, UNEP Clean-Up Programme/UNOPS, 2002

Report on Air Quality Monitoring in Kragujevac for the year 2002 (in Serbian), Ministry of Natural Resources and Environmental Protection, Republic of Serbia, 2003

Report on emission measurements from the emitters at HIP Petrohemija, Pancevo, 2003.

Report on Sampling and Analysis Results of Water and Sediment from Canal in Pancevo Industrial Complex Waste Characterization and Particle Size Distribution, IPH Belgrade 2001.

Report: *Investigation and Assessment of the Air Quality in the Area Impacted by Industry Complex "Kolubara prerada", Vreoci, for the period 1.06.2002 31.05.2003* (in Serbian), Mining Institute-Belgrade, 2003

Report: *Operation of Groundwater Remediation System at HIP Petrohemija, Final Report for Period Janu ary November 2003*, Dekonta, UNEP Clean-Up Programme/UNOPS Report, 2003.

Serbia and Montenegro, Country Environmental Analysis, World Bank, 2003

Study on Wastewater Generation, Collection and Treatment in Pancevo Industrial Complex, UNEP Clean-Up Programme, 2002.

The Kosovo Conflict Consequences for the Environment and Human Settlements, UNEP-UNCHS October 1999

The National Waste Management Strategy, including the program of harmonization with the EU, Republic of Serbia, Ministry of Natural Resources and Environmental Protection, Republic of Serbia, 2003

UN, Common Country Assessment for Serbia and Montenegro, October 2003.

UNEP Balkan Task Force: *Feasibility Study Environmental Hot Spots*, April 2000

ANNEX 2: ENVIRONMENTAL ISSUES OBSERVED AT SITES VISITED BY ASSESSMENT MISSION – SUMMARY TABLE

	Pancevo Petrochemical	Pancevo Oil Refinery	Pancevo Fertilizer	Novi Sad Oil Refinery	Zastava Group	Kragujevac Landfill	RTB Bor	Zorka Industrial Complex	Sabac Landfill	Niksic Steelworks	Kolubara Coal Processing	Kolubara Power Plant
Land Management Issues												
Contamination by chemicals / hydrocarbons	X	O		X								
Improper storage of waste and chemicals	X	X			X	O	O	X		X		
Land Degradation / Use changes						X	X		X		O	O
Air Related Issues												
Particulate Matter	O	O			X		X			X	O	X
SO_2	X	X			X		X			O	X	X
No_x	O	O	X		O							O
Ammonia			X					O				
Fugitive Emissions	O	X	O	O	X	X	X	O	O	X	X	O
Asbestos	O		O	O	O	O	O	O	O	O	O	O
Legionella					O		O	O		O		O
Water Related Issues												
Wastewater Treatment Plants	O*	O	X	O	X		X	O		O	X	O
Contamination of Ground Water	X	X		X		O		O	O			X
Contamination of Surface Water	X	X	X	O	X	O	X	O	O	X	X	O
PCB Management	O	O	O	O	X		X	O		O	O	O
Waste Management												
Hazardous Waste Management	X	X		X	X	X	O	X	O	O	O	O
Non Hazardous Waste Management	O	O	O	O	X	O	O	X	O	O	O	O
Permits and Compliance												
Water Permits		O	O	O	O		O	O		O	O	O
Air Quality Regulations	O	O	O		O		O	O		O	O	O
Public Complaints	O	O	O	O	O	O	O	O	O	O	O	O
Health and Safety of Workers	O	O	O	O	O	O	O	O	O	O	O	O

O = There is evidence that this is/may be an issue at this location

X = There is evidence that this is a major issue at this location

* Issues related to management system (including monitoring, emergency responser etc.)

ANNEX 3: LIST OF PROJECTS IDENTIFIED IN THE UNEP FEASIBILITY STUDY (2000) AND IMPLEMENTATION MEASURES

Novi Sad

Objectives	*Key Local Partner Organisations*
- Protection of groundwater, particularly drinking water	- Novi Sad Water Works
- Preventing pollution to reach Danube system	- Municipality of Novi Sad
- Reducing health risk to refinery workers	- NIS Oil Refinery
	- Institute "Jaroslav Cerni"

- Novi Sad Oil Refinery

Issue	*Description of project*	*Project no.*	*Implementation*
Groundwater contamination (on site)	I) Remediation of free phase oil on the groundwater table	NS.1	UNEP (partly), complementary investigations and pilot-remediation by Czech partners
	II) Preventing oil contaminated groundwater at the oil refinery to reach the Danube river and thereby the infiltration galleries (Southern premises)	NS.2	Not implemented
	III) Preventing oil contaminated groundwater at the oil refinery to reach the infiltration galleries (Eastern premises)	NS.3	UNEP
	IV) Groundwater monitoring programme on the oil refinery	NS.4	UNEP
Groundwater contamination (off site)	Groundwater monitoring programme outside the refinery	NS.5	SDC (Swiss Agency for Development and Cooperation), In 2003 taken over by UNEP, merged with NS.4
Soil contamination	Remediation of highly contaminated soil	NS.6	Not implemented
Leaking oil sewerage system	Repair of the pipeline system for oil-wastewater	NS.7	
	- Repair of Wastewater Collector outside Novi Sad Oil Refinery	NS.7.1	UNEP
	- Repair of Pipeline system for oil-wastewater (inside refinery)	NS.7.2	Refinery, in cooperation with Czech partners & national authority (partly)

Kragujevac

Objectives	*Key Local Partner Organisations*
- Reducing health risks for factory workers	- Zastava Car factory - Zastava Automobili
- Preventing pollution to the Lepenica river system	- Kragujevac University (Faculty of Science, Institute of Chemistry and Institute of Biology)
- Preventing immediate risk from storage of hazardous waste	

Issue	*Description of project*	*Project no.*	*Implementation*
PCB-contaminated floor in the paint hall	Removal of PCB-contaminated concrete, adding a new layer of concrete	KR.1	UNEP
PCB-contaminated water/ sediment in pits in the paint hall	Cleaning of the water pits and decontamination of the water	KR.2	UNEP
PCB-leakage with risk of contamination to river Lepenica and agricultural fields	Survey and monitoring on the extent of contamination of soils, surface and groundwater in the surroundings of Zastava car factory (co-ordinated with existing SDR programme)	KR.3	National Environmental Authorities
PCB-contaminated floor at the power station	Removal of PCB-contaminated concrete and sand, adding a new layer of concrete	KR.4	UNEP
PCB and PCDD/F-containing waste	Transportation and treatment of PCB and PCDD/F-containing waste abroad	KR.5	UNEP

Bor

Objectives	*Key Local Partner Organisations*
- Reducing health risks for factory workers	- Municipality of Bor
- Preventing immediate risk from storage of hazardous waste	- Bor Mining Complex - RTB Copper Mining and Refining Company

Issue	*Description of project*	*Project no.*	*Implementation*
PCB oil leakages and disposal of contaminated waste	Remedial actions concerning the PCB and dioxin contamination at the transformer station	B.1	UNEP
SO_2-emissions due to electricity shortage	SO^2-emissions have been reduced by local efforts to pre-conflict levels -> NO project proposal elaborated in the Feasibility Study		

Pancevo	
Objectives	***Key Local Partner Organisations***
- Protection of Danube system from critical pollution - Reducing health risk to factory workers - Protection of groundwater, particularly drinking water	- Pancevo Petrochemical Plant - HIP Petrochemical Plant - Pancevo Refinery - NIS Oil Refinery - Pancevo Fertilizer factory - Pancevo Azotara - Municipality of Pancevo

- Petrochemical plant

Issue	*Description of project*	*Project no.*	*Implementation*
EDC-contamination (of soil and groundwater)	I)Delimitation of the pollution and evaluating remediation techniques	PA.1	UNEP
	II) Remediation of EDC contaminated soil	PA.2	UNEP (partly)
	III) Remediation of EDC contaminated groundwater	PA.3	UNEP (complementary investigations and remediation measures implemented by Czech partners)
Groundwater contamination (on site)	Groundwater monitoring programme on the petrochemical plant	PA.4	SDC
Mercury contamination (of soil and groundwater)	Remediation of highly contaminated soil I) Delimitation of the pollution and evaluating suitable remediation techniques for remaining contaminated areas II) Remediation of contaminated soil	PA.5	SDC (incl. removal of most contaminated soil, safe temporary storage and feasibility study / risk assessment on further remediation measures)
Wastewater treatment	Cleaning and repair of the wastewater treatment plant	PA.6	UNEP
Possible leakage from sludge dump with toxic waste	I) Assessment of safety of the sludge dump and recommendations for action II) Monitoring programme	PA.7	Not implemented

- Refinery

Issue	*Description of project*	*Project no.*	*Implementation*
Soil contamination	Remediation of highly contaminated soil	PA.8	Not implemented
Groundwater contamination (on site)	I) Remediation of free phase oil on the groundwater table	PA.9	Not implemented
	II) Groundwater monitoring programme on the oil refinery	PA.10	SDC
Ponded oil and oil derivatives at the soil surface	Construction of a concrete basin for oil sludge	PA.11	UNEP
Wastewater pre-treatment and leaking sewerage sys.	Cleaning and repair of sewer-pipelines and oil-separators	PA.12	UNEP

- Wastewater canal

Issue	*Description of project*	*Project no.*	*Implementation*
Highly contaminated canal, open to the Danube	Preventing the release of EDC and sediment-associated pollutants into the Danube river system. Closing of the canal with temporary dam, dredging of sediment and disposal of waste at secured waste disposal site (incl. construction of hazardous waste disposal site) or on-site treatment of sediment.	PA.13	UNEP (only phase 1) PA.13.1: Preparation of Technical Documentation and Design for Remediation measures

- Groundwater contamination downstream from Pancevo industrial complex

Issue	*Description of project*	*Project no.*	*Implementation*
Risk for contamination of potable water supply	Groundwater monitoring programme outside the industrial complex	PA.14	SDC, Pancevo Municipality (in part)

ANNEX 4: UNEP CLEAN-UP PROGRAMME PROJECT SUMMARIES AND FINANCIAL INFORMATION

UNEP Clean-up of environmental hot spots

In June 1999, the joint UNEP/UNCHS Balkans Task Force (BTF) started to analyse the consequences for the environment and human settlements of the military actions in the FRY. The work was presented in a report entitled "The Kosovo Conflict - Consequences for the Environment and Human Settlements" (October 1999). The report highlighted a number of important conclusions on the post conflict situation in the area and in particular singled out four heavily polluted environmental "hot spots" (Pancevo, Kragujevac, Novi Sad and Bor), for immediate humanitarian assistance.

Reactions from a number of governments, the European Union and international organisations encouraged UNEP to carry out a detailed feasibility study, to clearly define the scientific and financial requirements for the clean-up of the "hot spots". Thus the October 1999 report was followed in February 2000 by a feasibility study, finalized in April 2000 that identified 27 clean-up projects (with total value of approx US$ 20 million) to address the post-conflict environmental and humanitarian problems.

Following active fund raising activities UNEP was able to launch the Clean-Up Programme in August 2000. Between August 2000 and April 2004 UNEP implemented clean up priority projects aiming to reduce environmental risks caused by the Kosovo conflict at the identified four "hot spots" sites.

Financial Summary

Ten donors supported the Programme with a total of US$ 12.5 million, with some 5 million received by end 2000 and the remainder during the course of 2001. Taking into account the limited resources, a careful prioritisation process was undertaken by UNEP in cooperation with the local and national partners. The following criteria were used for an overall assessment and prioritisation of the different impact mitigation measures:

(a) Urgency of impact mitigation

(b) Relevance for a large number of people and/or a large area

(c) Relevance for humans and/or the environment over a long period of time

(d) Environmental return

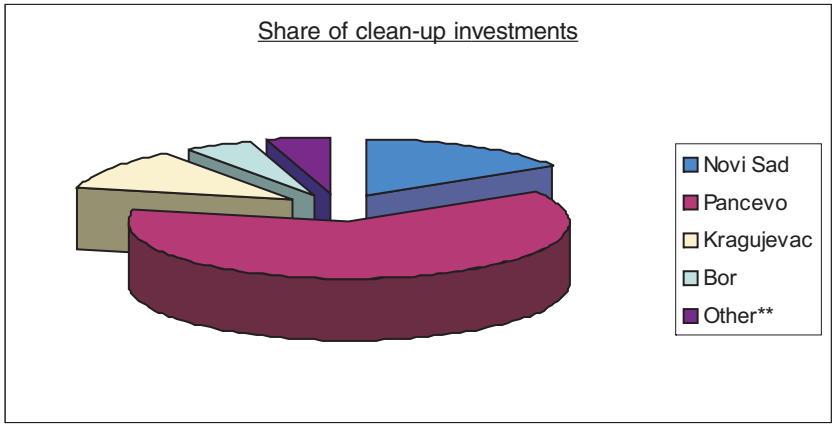
(e) Sustainability

Due to their integrated and interrelated nature (some being preconditions for other projects) projects needed to be implemented in a step-wise manner. The prioritisation process was further impacted by site-specific situations and developments as well as the availability of financial resources. Within its mandate the UNEP Clean-up Programme only addressed conflict -related humanitarian problems.

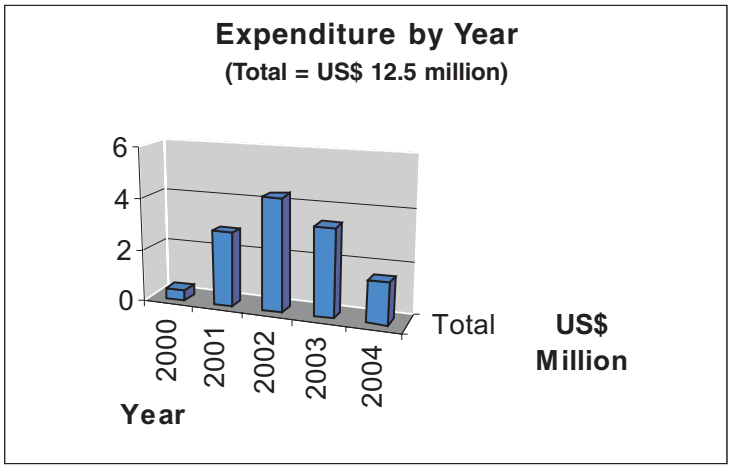
Ten donors supported UNEP's Clean-up Programme with a total of US$ 12.5 million

Country	Commitment in USD (approximate)
Denmark	2 730. 000
Finland	1 500.000
France	20. 000
Germany	870.000
Ireland	580.000
Luxembourg	360.000
The Netherlands	2 940.000
Norway	2 558.000
Sweden	970.000
Switzerland	57.000
Total (Commitments paid in several instalments during 2000-2003)	**12.5 million**

Note: In addition, in 2000-2003 SDC (Swiss Agency for Development and Cooperation) directly implemented monitoring and remediation projects at the 'hot spots'. Furthermore, certain donors (e.g. the Czech Republic), the national authorities in Serbia and Montenegro, and site owners, directly implemented and financed some clean-up activities at the four hot spots. These activities were complementary to the UNEP Clean-up Programme.



**Includes capacity-building workshops



Institutional Set-up and Mandate

UNEP had the overall responsibility of the programme and, in cooperation with its implementing partner the United Nations Office for Project Services (UNOPS), coordinated all environmental projects and activities related to the humanitarian environmental clean-up projects identified in the Feasibility Study. In support of the programme's implementation phase, a Project Implementation Office (PIO) in Belgrade was established by January 2001.

The Clean Up programme's institutional framework was based on the following agreements:

- Memorandum of Understanding between UNEP and Serbia and Montenegro (former FRY) Government outlining the main objectives and activities of the programme, its institutional framework and confirmation of privileges and immunities.

- Memorandum of Understanding for each environmental "hot spot" between UNEP and local stakeholders, incl. the municipality and/or municipal services and Site Owner(s).

Coordination mechanisms comprised regular National Coordination Group meetings convened by the Government focal point, local coordination meetings at the four municipalities as well as annual donor briefings.

While the main aim was to rapidly reduce the most severe risks at the selected sites, the Programme has also created know-how for future complicated environmental remediation in post-conflict areas.

The operational guiding principles of the Programme were:

- Limit to/focus on the humanitarian approach
- Deliver the assistance as soon as possible
- Respect the national and local legislation and regulation
- Act in accordance with international standards on environmental management
- Apply clean technology principles
- Strengthen local and national capacities on environmental management
- Promote and support local solutions to identified problems
- Provide positive input to environmental awareness raising

Summary of Project Activities

Many of the identified environmental problems at the four hotspots were complex and required extensive studies and engineering preparations as well as very specific skills in remediation. After the establishment of the necessary legal and management capacities, and, ensuring availability of minimum funds, the implementation of the works started in 2001.

Altogether, UNEP implemented 16 projects. In addition, Swiss Development Cooperation implemented 5 smaller projects, primarily monitoring projects as identified in the UNEP Feasibility Study (2000). In the case of the Pancevo Canal Project (PA 13), UNEP has not implemented the actual clean-up works, but only produced the technical documentation necessary for the implementation. All completed projects have been handed over to the site owners before closure of Clean-up Programme in April 2004.

The capacity building activities implemented in connection with the clean-up activities were chosen with the view to provide support for efficient implementation of the clean-up works. In addition, the objective was to support local stakeholders in areas that strengthen their capacity to identify their environmental priorities. The seminars and workshops covered issues like Multilateral Environmental Agreements, Sustainable Consumption, Local Environmental Action Plans, Foreign Direct Investments – Financing Sustainability, Hazardous Waste Management and Cleaner Production.

The following provides for a summary of all projects implemented by UNEP Clean-up Programme and their key components. The project codes follow the numbering used in UNEP. Feasibility Study (2000), which provides the central framework for the projects implemented within the programme. Some of the projects identified in the FS have been modified or project approaches amended, in order to address in the most efficient way the priority problems at the four sites. As can be noted from the total list of projects identified in the FS, some projects have been implemented by other international partners or local//national stakeholders or not or only partly implemented (see Annex 3). In addition, 2 project extensions have been implemented by UNEP in Bor (ref. capacity building activities related to environmental monitoring and LEAP process), and two complementary sub-projects in Baric and Pancevo (ref. hazardous waste management).

Locations of UNEP clean-up activities at environmental hot spots

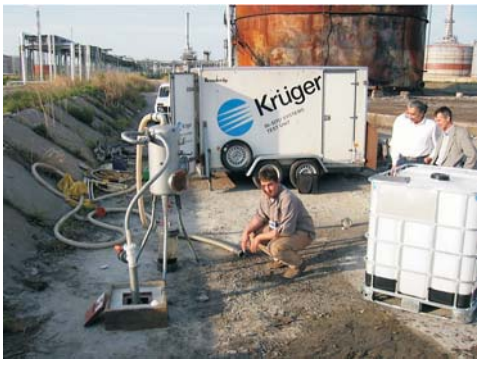
CLEAN-UP WORKS – project summaries

Novi Sad

Project title (code):	**Remediation of free-phase oil at the groundwater table (NS.1)**
Location:	NIS Oil Refinery Novi Sad
Problem definition:	Presence of free-phase oil threatens groundwater and drinking water quality in the Ratno Ostrvo catchment area
Objective:	Protection of drinking water sources in the Ratno Ostrvo area
Activities:	1. Preparation and planning; 2. Subsurface characterization, installation of remediation wells; 3. Pilot tests, performance and evaluation; 4. Design and delivery of mobile remediation unit; 5. Operation of mobile remediation unit; 6. Delivery of equipment for expansion of remediation system - connecting of additional remediation wells.
Duration and project output:	March 2002 - February 2004. By January 2004 approximately 4.5 tonnes of free phase oil had been recovered. In February 2004, the mobile abstraction / separation unit was handed over to Novi Sad refinery, which is responsible for the continued operation of the unit.

Bomb damage at NIS Oil Refinery Novi Sad, June 1999

Bomb damage to oil pipeline at Novi Sad refinery, June 1999



Novi Sad - Oil refinery: free phase remediation, pilot phase, May 2002

Remediation of free-phase oil on the groundwater table at Novi Sad refinery, January 2004

Project title (code):	**Construction of a hydraulic barrier (NS.3)**
Location:	Between NIS Oil Refinery Novi Sad and water supply wells at Ratno Ostrvo
Problem definition:	Large quantities of crude oil and oil products leaked into soil and groundwater at the oil refinery creating risk to drinking water source at RatnoOstrvo
Objective:	Protection of drinking water sources in the Ratno Ostrvo area, by preventing groundwater contamination from refinery to reach drinking water wells
Activities:	1. Preparation and planning; 2. Drilling of pumping and monitoring wells; 3. Construction of well shafts; 4. Construction of system for water evacuation (earth works, pipelines) 5. Delivery and installation of mechanical equipment; 6. Delivery and installation of electrical equipment; 7. Construction of command-control centre; 8. Test-run and handover
Duration and Project output:	June 2001 - February 2002 The barrier is fully operational and ready for start-up if/when needed. Handover of hydraulic barrier to Novi Sad Waterworks/Municipality took place in April 2002.

Protection of groundwater resources at Ratno Ostrvo, risk reduction component completed in spring 2002 and handed over to city of Novi Sad

Project title (code):	**Groundwater monitoring in the Ratno ostrvo area: inside (NS.4) and outside (NS.5) of NIS Oil Refinery Novi Sad**
Location:	Ratno Ostrvo groundwater source area
Problem definition:	Oil spills at NIS Oil Refinery Novi Sad have contaminated the groundwater and created contamination risks to water supply wells
Objective:	Protection of drinking water sources of the city of Novi Sad at Ratno Ostrvo
Activities:	1. Preparation and planning; 2. Installation of monitoring wells; 3. Sampling and chemical analyses; 4. Preparation of numerical groundwater flow model of Ratno Ostrvo groundwater area
Duration and Project output:	November 2000 - September 2003 Extent of groundwater pollution, pace and preferential pathways of contaminant migration from the source zone have been identified. Criteria for start-up of hydraulic barrier operation were defined. Monitoring programme and wells were handed over to Novi Sad Municipality and NIS oil refinery in February 2004

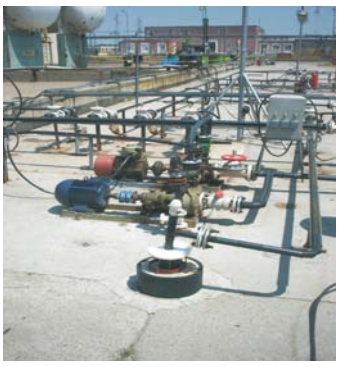
Project title (code):	**Repair of Wastewater Collector outside Novi Sad Oil Refinery (NS.7.1)**
Location:	Area outside Novi Sad oil refinery and in the vicinity of Novi Sad Water Works source area Ratno Ostrvo
Problem definition:	Severe leakage from damaged wastewater collector of NS oil-refinery has been polluting groundwater and threatening drinking water wells. The collector is a 2.2 km long, buried concrete structure, with interior 2.5m wide and 1.5m high, used to convey wastewater from oil refinery, across Ratno Ostrvo water wells area, to the Danube. Both the collector and the wells are operated and maintained by Novi Sad Waterworks (NSWW).
Objective:	Protection of the drinking source area of Novi Sad.
Activities:	1. Preparation and planning; 2. Construction of temporary bypass for refinery's wastewater via "Cuvarev" channel 3. Removal of sludge from the collector and detailed cleaning of the whole interior; 4. Detailed inspection and mapping of all damages and defects in the collector; 5. Repair of the collector interior and removal of the by-pass.
Duration and Project output:	September 2001 - September 2003 Leaking spots in the collector were sealed, and consequent pollution of the groundwater has been prevented, enabling re-use of the collector. Hand-over to Novi Sad Waterworks /Municipality took place in February 2004.

Inside of the collector prior to repair works

Pancevo

Project title (code):	**EDC Remediation Activities (PA.1-3)**
Location:	HIP Petrohemija Pancevo
Problem definition:	High pollution of soil and groundwater caused by EDC spill at HIP PetroHemija
Objective:	Reducing of health risk for the factory workers, protection of groundwater sources and Danube River.
Activities:	1. Preparation and planning; 2. Subsurface characterization; 3. Pilot tests, performance and evaluation; 4. Preliminary risk assessment; 5. Selection of remedial technology; 6. Operation of interim remedial system; 7. Upgrade of EDC treatment facilities (from initial 3.5 m3/hour to 16 m3/hour); 8. Design, installation and commissioning of full-scale remedial system for shallow aquifer clean-up.; Setting of clean up targets.
Duration and Project output:	June 2001 - April 2004 By January 2004 over 400 tonnes of EDC had been recovered Hand-over of the full-scale remediation system to Site Owner, responsible for the continued operation, took place in April 2004.

Bomb damage at Pancevo pertochemical plant, HIP Petrohemija Pancevo, May-June 1999



EDC Remediation - pumping of free-phase EDC and contaminated groundwater (left), discharge of treated water (right) at HIP PetroHemija Pancevo

Project title (code):	**Rehabilitation of the wastewater treatment plant (PA.6)**
Location:	Wastewater treatment plant (WWTP) at HIP Petrohemija
Problem definition:	The WWTP capacity significantly reduced because of serious oil contamination. Vital process units and equipment are damaged.
Objective:	Protection of Danube river system and downstream drinking water supplies.
Activities:	1. Replacement of process equipment (pumps, instrumental equipment, pipes, fixtures); 2. Repair of the Trickling filter (emptying and cleaning of the filter, repair of the filter structure, supply and installation of new equipment and filter media); 3. Repair of the Activated sludge (repair of structure, supply and installation of new aeration equipment); 4. Repair of pH regulating facility (repair of structures, supply and installation of new pH regulating equipment).
Duration and Project output:	June 2001 - April 2004 Hydraulic and treatment capacity of WWTP has been restored and improved compared to pre-conflict levels, reducing pollutant loading to the Danube and reducing risks to downstream water supplies. Handover of project investments, management and supervision responsibilities to Site Owner took place in April 2004

Rehabilitation of WWTP, trickling filter interior, at HIP Petrohemija December 2001



Trickling filter in operation, January 2004 (left). Repaired activated sludge basin interior (middle) and acid dosing pumps (right), January 2004


Rehabilitation of the WWTP trickling filter structure, June 2002 (left).
Testing of new trickling filter equipment, December 2003 (right)

Project title (code):	**Construction of Concrete Basin for Oil-sludge at NIS Oil Refinery (PA.11)**
Location:	NIS Oil Refinery Pancevo
Problem definition:	Spilled oil and oil products could not be removed due insufficient storage facilities for oil sludge. The new concrete basin is designed as impervious storage with capacity of 1640 m^3
Objective:	Reducing of health risk for the factory workers.
Activities:	1. Preparation and planning; 2. Construction of 1640m3 impervious concrete basin with oil-separator; 3. Construction of fire-fighting raw water pipeline to the basin; 4. Construction of access road the basin.
Duration and Project output:	September 2001 - April 2003 Temporary storage capacity for the clean-up operations at the refinery were provided. The facilities were handed over to the Site Owner in June 03.

Old concrete basin at NIS Oil Refinery Pancevo, September 2001


Construction works (middle) and the new concrete basin (right), March – November 2002

Project title (code):	**Repair of Oil-separators at NIS Oil Refinery Pancevo (PA.12.1)**
Location:	NIS Oil Refinery Pancevo
Problem definition:	Spilled oil, oil products, debris and chemicals clogged the refinery's sewerage, clogged and damaged oil-separators, reducing functionality of the refinery's system for wastewater pre-treatment, resulting in increased pollution of the area
Objective:	To reconstruct and up-grade functionality of the oil-separators, thus reducing of health risk for the factory workers and protection of the area and the Danube against ongoing pollution.
Activities:	1. Preparation and planning; 2. Providing of necessary designs for civil, and equipment works; 3. Cleaning, repair and reconstruction of the oil-separators concrete structure; 4. Procurement and supply of new equipment, including scrapers, filters, pumps and instrumentation; 5. Repair of existing and installation of new equipment; 6. Commissioning, test run and handing over to the site Owner.
Duration and Project output:	December 2001 - April 2004 Wastewater pre-treatment facilities have been repaired and upgraded with improved efficiency, resulting in reduction of the pollution of the area and Danube river. Handover to Site-Owner took place in 2004.

Pre-treatment facilities prior to rehabilitation, June 2002

Concrete works and installation of equipment, August – October 2003

Concrete works and installation of equipment, August – October 2003

Rehabilitation of oil-separator completed, November 2003

Project title (code):	**Repair of Wastewater Pipeline between NIS Oil Refinery and HIP Petrohemija Pancevo (PA.12.2)**
Location:	Industrial zone between NIS Oil Refinery (RNP) and HIP Petrohemija in Pancevo
Problem definition:	Spilled oil, oil products, debris and chemicals clogged wastewater pipeline conveying oily wastewater from oil separators at RNP to HIP Petrohemija's WWTP for final treatment. The wastewater pipeline is 600mm in diameter, total length of 2.4 km and 11 concrete shafts with section valves, drain outlets and air vents.
Objective:	To repair the pipeline, thus reducing of health risk for the factory workers and protection of the area and the Danube against ongoing pollution
Activities:	1. Preparation and planning; 2. Providing of necessary designs for civil, and equipment works; 3. Cleaning and repair of the pipeline; 4. Procurement, supply and installation of new equipment to replace the existing, including: air valves, drain outlets, joints, and main valve; 5. Hydraulic testing; 6. Commissioning, test run and handing over to the site Owner.
Duration and Project output:	April 2002 - April 2004 The repair of the wastewater pipeline between the refinery and the petrochemical plant, completed in February 2004, enables transport of pre-treated wastewaters from refinery to WWTP before discharge to wastewater canal. Handover to Site Owner took place in April 2004

Beginning of the pipeline from NIS Oil Refinery to HIP Petrohemija Pancevo, September 2002

Damaged section in the pipeline from NIS Oil Refinery to HIP Petrohemija Pancevo, September 2002

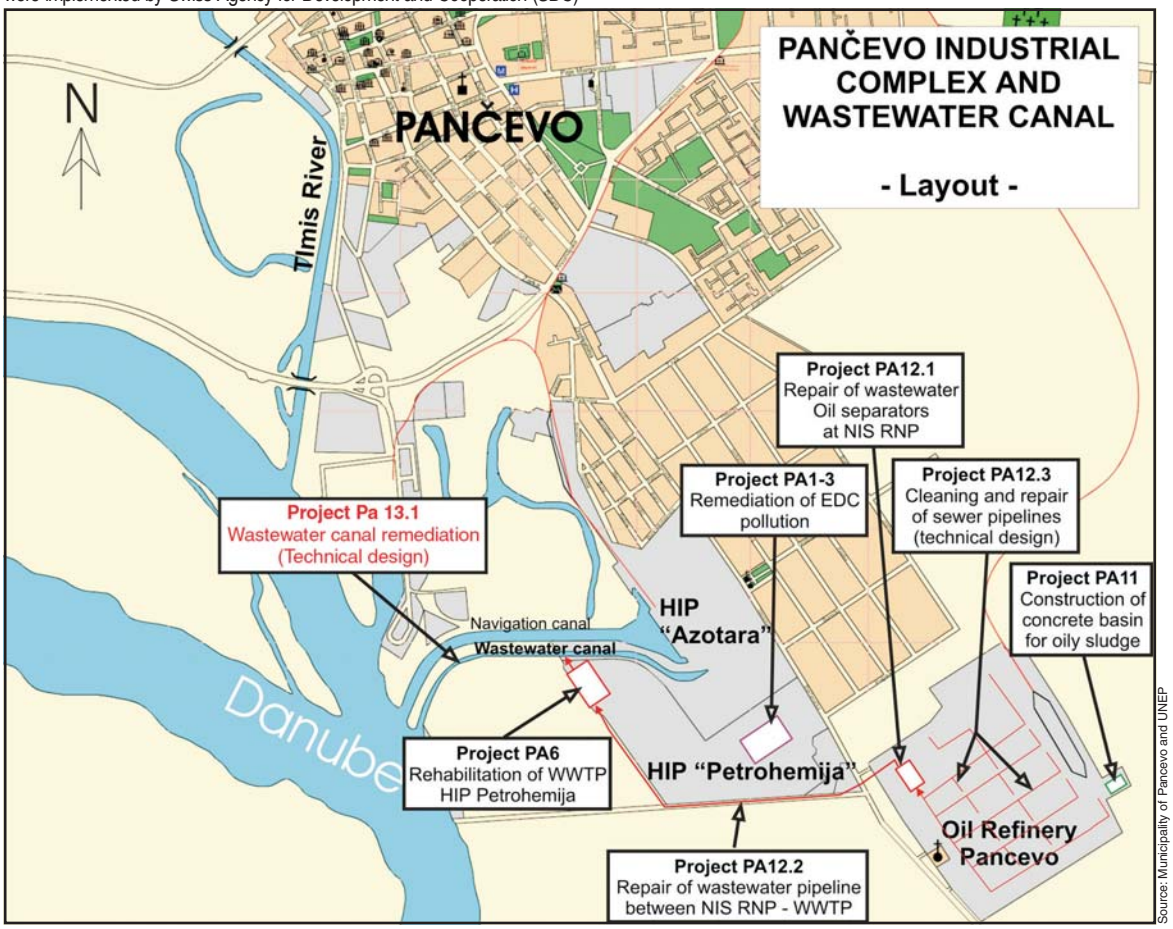
Project title (code):	**Rehabilitation of Oily and Storm Sewerage System in NIS Oil Refinery Pancevo - Technical Design (PA.12.3)**
Location:	NIS Oil Refinery in Pancevo
Problem definition:	Spilled oil, debris and chemicals clogged the pipeline system, which is partly broken or damaged. Storm and Oily sewerage systems are not completely separated, thus reducing functionality of the refinery's sewerage system and wastewater pre-treatment facilities
Objective:	Reducing health risk for factory workers and protection of the area, groundwater sources and protection of the Danube.
Activities:	1. Preparation and planning; 2. Survey of present condition of the sewerage system; 3. Investigation works necessary for the Final Design elaboration; 4. Preparation of the Final Design for rehabilitation of the sewerage system; 5. Additional Investigation works on measurement of wastewater quantities generated from Refinery's process plants, needed for defining a proper management of the wastewaters within Refinery; 6. Preparation of the Study for management of the wastewater quantities in the integrated system connecting the pre-treatment facilities in Refinery with the WWTP in HIP Petrohemija. 7. Implementation of the rehabilitation works by the site Owner (ongoing since Sept. 03)
Duration and Project output:	July 2002 - April 2004 Technical solutions for rehabilitation of Refinery's Sewerage System and for the proper management of the wastewater have been elaborated. Handover of Technical Study/Design Documents to Site Owner took place in April 2004.

Malfunctions in sewerage system at NIS Oil Refinery, November 2002

Spilled oil at NIS Oil Refinery, Pancevo

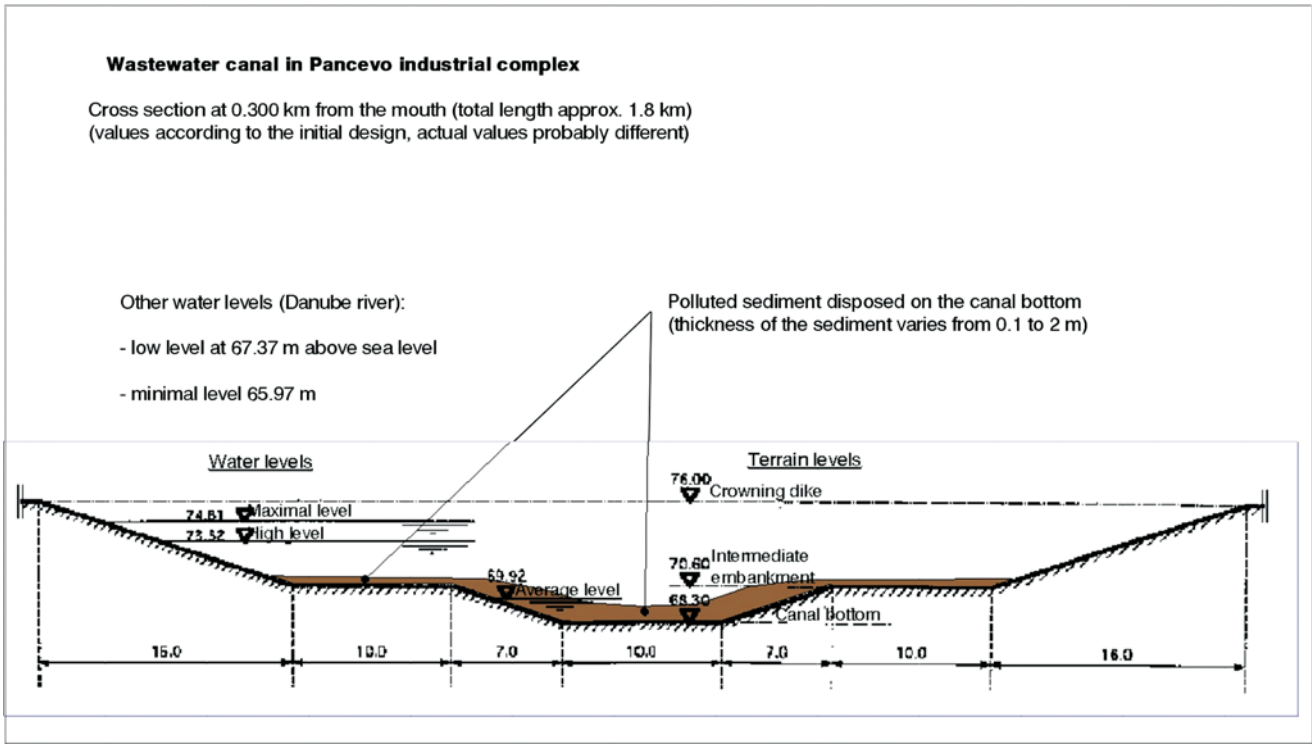
Project title (code):	**Wastewater Canal Remediation Phase 1: Preparation of Technical Documentation and Design (PA.13.1)**
Location:	Wastewater canal connecting industrial complex with the Danube
Problem definition:	The Danube river is permanently contaminated with sediment associated pollutants from the canal, causing also potential risk to groundwaters.
Objective:	Protection of downstream drinking water resources and the river Danube
Activities:	1. Pre-design investigation works (geodetic survey, sampling and analyses of water and sediment, waste characterization) 2. Preparation of General design (additional field and laboratory analyses, review and selection of remediation technology, preparation of design in accordance with national regulations and EU standards) 3. Preparation of Final design and tender documents in accordance with investor requirements
Duration and Project output:	May 2001 - April 2004 Pre-design investigation works were completed in 2001 and all documents have been shared with local stakeholders and national competent authorities. The sediment has been comprehensively characterized. General Design (GD) and preliminary Environmental Impact Assessments (pEIA) for 2 remedial options undertaken: landfill and thermal desorption (TD). Preparation of Final design and tender documents (not within UNEP Clean-Up Programme) can start after successful completion and approval of General design and pEIA. Preconditions for design and tender preparation are that reliable systems for prevention of pollution spills into the canal are established at industrial complex and funding issue solved by Serbian stakeholders in cooperation with theirl partners.

Note: Risk reduction projects related to mercury contamination were implemented by Swiss Agency for Development and Cooperation (SDC)



Closely interlinked UNEP Clean-Up Projects at Pancevo industrial complex

Pancevo wastewater canal at the industrial complex, August 1999



Designed cross section of the wastewater canal

Pancevo wastewater canal, upstream part at the industrial complex, May 2002

Kragujevac

Project title (code):	**Remediation of PCB contaminated concrete floor at "Zastava" paint hall (KR.1)**
Location:	Zastava Car Factory, paint hall and UP-8 site
Problem definition:	Concrete floor in the paint hall is contaminated with PCBs. Two damaged transformers from the paint hall and associated PCB-waste improperly stored at unprotected UP-8 site
Objective:	Reducing health risks for factory workers, enabling reuse of effected part of the floor
Activities:	1. Sampling and analyses of contaminated concrete floor and PCB-waste at UP-8 site; 2. Design preparation and international Tendering for the works; 3. Supply of UN-approved packaging; 4. Removal and packing of contaminated layers of concrete/soil, including verification of de-contamination works; 5. Placing new soil/concrete layers, application of anti-static epoxy raisin over concrete; 6. Re-packing of hazardous waste (HW) at UP-8 site in UN-approved packaging; 7. Waste characterization, labeling and temporary storing of resulting HW (135 tons), ready for transportation and incineration abroad; 8. Preparation of HW Inventory lists.
Duration and Project output:	January 2001 - August 2002 The remediation activities were successfully completed enabling reuse of effected part of the paint hall.

"Zastava" paint hall after bombing, June 1999

Covering of reclaimed area in paint hall with new concrete, March 2002

Re-packing of hazardous waste at UP-8 site, March 2002

Project title (code):	**Cleaning of the wastewater pits and decontamination of wastewater in "Zastava Automobili" paint hall (KR.2)**
Location:	Zastava Car Factory, Paint hall
Problem definition:	Wastewater pits in the paint hall and existing equipment contaminated with PCBs. Large amounts of contaminated miscellaneous debris in the pits.
Objective:	Reducing health risks for factory workers, enabling reuse of the pits, as well as protecting nearby water resources (Lepenica River).
Activities:	1. Sampling and analyses of contaminated wastewater, debris and equipment; 2. Design preparation and tendering for the works; 3. Removal from the pits and treatment of PCB contaminated wastewater (6.000 m3); 4. Removal from the pits of contaminated debris and bottom sediment (120 tons); 5. Dismantling, decontamination and disposal of the equipment (10 tons) from the pits; 6. Verification of de-contamination works; 7. Waste characterization, packing, labeling and temporary storing of HW resulting from clean-up activities, ready for transportation and incineration abroad; 8. Preparation of HW Inventory lists.
Duration and Project output:	January 2001 - April 2002 The remediation activities were successfully completed enabling reuse of decontaminated pits.

PCB contaminated wastewater pit in paint hall, August 2001

Device for treatment of PCB-contaminated wastewater from paint hall pits, January 2002

Sludge from paint hall pits packed in UN-approved Drums, February 2002

Project title (code):	**Remediation of PCB contamination at "Zastava Energetika" transformer station (KR.4)**
Location:	"Zastava Energetika" transformer station
Problem definition:	Transformer pit and adjacent concrete floor at transformer station contaminated by PCBs
Objective:	Reducing health risks to factory workers, enabling reuse of transformer station that provides power supply to the factory and heating to the city (approx. 40% of households)
Activities:	1. Sampling and analyses of the contaminated site; 2. Design preparation and tendering for the works; 3. Supply of UN-approved packaging; 4. Removal and packing of contaminated layers of concrete/soil, including verification of de-contamination works; 4. Placing of a new soil/concrete layer and restoring the transformer pit; 5. Re-installation of the transformer; 6. Waste characterization, packing, labeling and temporary storing of HW resulting from clean-up activities (50 tons); 7. Preparation of HW Inventory lists.
Duration and Project output:	June 2002- October 2002 All activities were succesfully completed, enabling reuse of effected part of transformer station

Clean-up works under protective tent at "Zastava Energetika" transformer station, September 2002

Transformer station site after removal of protective tent, September 2002

PCB-contaminated material packed in UN-approved drums for temporary storage, October 2002

Project title (code):	**Transboundary movement and Disposal of HW resulting from KR.1, KR.2 and KR.4 remediation/clean-up works (KR.5)**
Location:	Zastava Car Factory
Problem definition:	HW resulting from KR.1 & KR.2 (265 tons) and KR.4 (50 tons) clean-up works, packed and temporary stored at factory premises require final treatment. Approved site or facility for environmentally sound disposal of HW does not exist in Serbia & Montenegro.
Objective:	Environmentally sound final treatment/disposal of HW resulting from KR.1, KR.2 and KR.4 projects, thus preventing risks arising from storage of HW at factory premises.
Activities:	1. Defining of environmentally sound management requirements for the project (according to Basel Convention on control of transboundary movement of HW and their disposal); 2. International Tendering procedure for transportation and disposal of HW; 3. Notification procedure in accordance to BC, export license, movement documents; 4. Trans-boundary movement of HW from "Zastava" to authorized disposal facilities abroad; 5. Disposal of HW at the authorized facilities; 6. Certificates of completed HW disposal.
Duration and Project output:	February 2002 - October 2003 (12 months for KR1 & KR.2, and 10 months for project KR 4) In total approx 315 tones of hazardous waste were removed from the sites and disposed of abroad according to environmentally sound management requirements.

Loading of hazardous waste (HW) drums into containers and securing the loading, ready for transportation, February 2002

Transportation by train of HW stored in containers to disposal facility abroad, August 2002

Unloading of damaged PCB-transformer at disposal facility, September 2002

Bor

Project title (code):	**Remedial actions concerning PCB contamination at the transformer station in Bor (B.1)**
Location:	Bor Mining and Smelting Company (RTB Bor), Transformer Station (T3) and Dump Site
Problem definition:	PCB contamination at transformer station No 3 in RTB-Bor was moved to Bor Dump Site and posing potential environmental risks to factory workers
Objective:	Reducing health risks for factory workers, Preventing immediate risk from storage of hazardous wastes
Activities:	1. PCB assessment of transformer station (T3 station) site; 2. PCB Risk Assessment of Dump Site; 3. Transport & Disposal abroad of Stored Capacitors with PCB from T3 station
Duration and Project output:	September 2001 - December 2003 Activities completed (activity 1, September 2001, 2. February 2003, and 3. December 2003). Risks posed by PCB contaminated capacitors reduced. RTB Bor, local and national authorities provided with risk assessment results, the proposed remediation measures and aware of environmental and health risks.

Transformer station (TS 3), destroyed by the bombing, June 1999

PCB containing capacitors stored at the site, removed and disposed, December 2003

Risk assessment at RTB Bor dump site, September 2002

UNEP provided further assistance to the Municipality of Bor, by assessing and improving environmental monitoring capacities in Bor area and by supporting the Local Environmental Action Plan process in Bor.

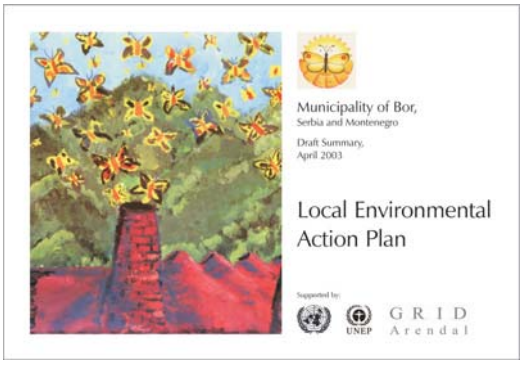
Project title (code):	**Support to Environmental Monitoring Capacities in Bor (Bor - Capacity Building 1)**
Location:	City of Bor and surroundings
Problem definition:	The collection, analysis, interpretation and distribution of environmental and health monitoring information in Bor area is not sufficient and coordinated.
Objective:	Provision of timely and reliable information to decision makers and the public about environmental conditions in the Bor area.
Activities:	1. Assessment of environmental monitoring capacities, February - May 2002 by UNEP interagency expert mission. Report identified air monitoring as highest priority area (Assessment of Environmental Monitoring Capacities in Bor area, Mission Report, September 2002 is available at http://postconflict.unep.ch/); 2. Supply and installation of priority air monitoring equipment, including 2 SO_2 stations, 1 Meteo station, 1 mobile Airborne Particulate (PM10) station and 1 mobile Airborne Toxic Particulate station; 3. Establishment of monitoring management system, training of local stakeholders in operating programme.
Duration and Project output:	February 2002 - April 2004 Bor stakeholders aware of existing monitoring capacities and priority areas for improvement. Air monitoring system in place that is accurate and transparent, providing internationally reliable monitoring information. Air monitoring equipment supplied and installed in June 2003 and operated by Bor Copper Institute. Establishment of management system for operating air monitoring system with participation by Municipality/LEAP office, IPH Zajecar, Bor Copper Insititute, Bor Medical Center, and Republican Environmental Inspector. Inauguration of monitoring system in October 2003, and Monitoring System handed over to Municipality of Bor in Aprily 2004. Official monitoring reporting started in January 2004.
Recommended future activities:	1. Periodic performance review of air monitoring and management systems. 2. Ensuring transparent use of monitoring results as basis for decision-making processes. Sharing monitoring results with all relevant stakeholders at local and national levels. 3. Further improvement of overall monitoring capacities in Bor based on assessment findings and recommendations.

Installation and Hand-over of monitoring equipment, at monitoring station in Bor City center, October 2003

Project title (code):	**Support to Local Environmental Action Plan (LEAP) process in Bor (Bor - Capacity Building 2)**
Location:	Municipality of Bor
Problem definition:	The environmental situation in Bor municipality requires the local stake-holders to plan and manage activities in a pragmatic and focused manner
Objective:	To provide Bor local stakeholders with sound planning and management tools in support of transparent, efficient and good quality environmental decision-making.
Activities:	Support developing a community vision, assessing environmental issues, setting priorities, identifying strategies for addressing problems, and project formulation for actions that achieve real environmental and public health improvements, including: 1. Technical and logistical support to seminars/workshops on specific LEAP steps/issues; 2. Logistical support to the LEAP Coordination Office; 3. Technical training of LEAP Coordination Staff (in Bor and Arendal/Norway); 4. Support to Networking/Fund Mobilization Efforts.
Duration and Project output:	March 2002 - September 2003 Bor stakeholders provided with a planning and management tool for improved local environmental management. Bor LEAP Stakeholder Group and Technical Teams were established in 2001 and LEAP Coordination Office fully equipped in January 2003. Draft LEAP Summary was presented in May 2003 at the Kiev Environment for Europe Conference. A series of workshops and internal meetings resulted in a LEAP document approved by Municipal Assembly in August 2003, and the launch of the LEAP implementation process by end 2003
Recommended future activities:	1. Continued support to LEAP process, by local, national as well as international partners. 2. Use of lessons learned for similar initiatives in Serbia and Montenegro and the region. 3. LEAP priorities to serve as input to regional/national development planning processes .

LEAP stakeholder meetings in 2002-2003

Draft LEAP summary presented at Kiev 'Environment for Europe' conference, May 2003



Bor LEAP summary document (draft April 2004)

Complementary sub-projects

During project implementation phase, priority projects complementary to projects listed in the Feasibility Study were identified, supporting the efficient implementation of UNEP clean-up programme.

Project title (code):	**Packing, trans-boundary movement and Disposal of HW from "Prva Iskra-Namenska", Baric (PIN - PCB removal)**
Location:	"Prva Iskra-Namenska" factory, Baric, Belgrade
Problem definition:	A cistern containing 15 m3 of PCB-oil temporary stored at factory premises close to the bank of river Sava, with potential risk for contamination of Belgrade water source area, located down stream of the site. Approved site or facility for environmentally sound disposal of HW does not exist in S & M.
Objective:	Disposal of HW in accordance with environmentally sound management requirements, thus preventing potential risk for contaminating of Belgrade water source area and health risk for factory workers.
Activities:	1. Defining of environmentally sound management requirements (ref. Basel Convention); 2. Sampling, analysis and waste characterization; 3. Packing works on site, labeling and preparation of HW Inventory list; 4. Notification procedure in accordance to BC, obtaining of export license, movement documents; 5. Trans-boundary movement of HW from "PIN", Baric to authorized disposal facility abroad; 6. Disposal of HW at authorized disposal facility, Certificates of HW disposed.
Duration and Project output:	December 2001 - November 2002 All activities were succesfully completed reducing potential risk for water source area of Belgrade as well as health risk for factory workers.

Sampling and packing of PCB- oil at Baric, September 2002

Packing of damaged PCB transformers at HIP PetroHemija, September 2002

Project title (code):	**Packing, trans-boundary movement and Disposal of HW from HIP Petrohemija, Pancevo (HIP - PCB removal)**
Location:	HIP Petrohemija factory, Pancevo
Problem definition:	Damaged PCB transformer and 3 tons of PCB waste collected in drums temporary stored at factory premises.
Objective:	Disposal of HW in accordance with environmentally sound management requirements, thus reducing risk for factory workers arising from storage of HW at factory premises.
Activities:	1. Defining of environmentally sound management requirements for the project; 2. Sampling, analysis and waste characterization; 3. Packing works on site, labeling and preparation of HW Inventory list; 4. Notification procedure in accordance with BC, obtaining export license, movement documents; 5. Trans-boundary movement of HW to the authorized disposal facilities abroad; 6. Disposal of HW at authorized disposal facility. Certificates of HW disposed.
Duration and Project output:	March 2002 - October 2002 All activities wre succesfully completed, with HW removed from factory premises, disposed of safely, reducing health risk for factory workers.

ANNEX 5: LIST OF CONTRIBUTORS

UNEP Post-Conflict Assessment Unit

Dr. Mario Burger, Project Coordinator
Mr. David Dunn, Special Advisor
Mr. Aniket Ghai, Programme Coordinator
Mr. Jon Godson, Senior Environmental Expert
Mr. Pekka Haavisto Chairman, UNEP Desk Study
Ms. Yoko Hagiwara, Programme Officer
Mr. Mikko Halonen, Environmental Expert
Ms. Mijke Hertoghs, Programme Officer
Mr. David Jensen, Project Coordinator
Mr. David Meadows, Programme Officer
Mr. Ola Nordbeck, Research Officer
Mr. Jussi Ojala, Research Assistant
Mr. Hassan Partow, Senior Environmental Expert
Mr. Matija Potočnik, Project Assistant
Ms. Céline Reichard, Research Assistant
Mr. Pasi Rinne, Senior Policy Advisor
Mr. Gabriel Rocha, Systems Administrator
Mr. Henrik Slotte, Head of Unit
Ms. Joanne Stutz, Programme Assistant
Mr. Muralee Thumarukudy, Project Coordinator
Mr. Koen Toonen, Programme Manager
Mr. Alain Wittig, Research Assistant
Mr. Richard Wood, Technical Coordinator
Mr. Grant Wroe-Street, Programme Officer
Mr. Ardeshir Zamani, Project Assistant

UNEP / UNOPS Clean-up Project Implementation Office

Mr. Roeland Kortas, Programme Manager
Mr. Zoran Dimkić, Sr. Civil Engineering Consultant
Mr. Aleksandar Đukić, Civil Engineering Consultant
Mr. Aleksandar Ložajić, Hydrogeology Consultant
Mr. Milan Tričković, Civil Engineering Consultant
Mr. Walton David, Regional Admin and Finance Officer
Ms. Sanja Gajica-Stojković, Finance Assistant
Ms. Vanja Jeličić, Admin/Finance Assistant
Ms. Irena Kirin, Procurement Assistant
Ms. Biljana Cvetković, Secretary/Interpreter
Ms. Nada Milovanović, Secretary/Admin Assistant
Ms. Snežana Bulatović, General Support Assistant
Mr. Slobodan Čvrkić, Driver
Mr. Goran Joković, Sr. Driver

Field mission participants, November 2003

UNEP mission team

Mr. Jon Godson	UNEP
Mr. Muralee Thumarukudy	UNEP
Ms. Mijke Hertoghs	UNEP
Mr. Aleksandar Lozajic	UNEP/UNOPS Project Implementation Office, Belgrade
Ms. Mirja Kosonen	International expert (Soil and Water Ltd /Environmental Consulting)
Mr. John Bennett	UNEP consultant, report editor
Mr. Mikko Halonen	UNEP, team leader

Serbian and Montenegro mission teams

Serbia

Ms. Radmila Serovic	Ministry for Science and Environmental Protection* (ministry coordinator)
Ms. Slavica Lekic	Ministry for Science and Environmental Protection
Ms. Rada Pecelj	Ministry for Science and Environmental Protection
Mr. Nebojsa Protic	Soil Institute, Belgrade
Ms. Mirjana Grbavcic	Institute for Technology of Nuclear Mineral Raw Materials, Serbia
Ms. Mirjana Stojanovic	Institute for Technology of Nuclear Mineral Raw Materials, Serbia
Mr. Slavisa Mladenovic	Institute of Public Health, IPH-Belgrade
Ms. Ljiljana Markovic	Kragujevac, republic environmental inspector
Mr. Dusan Kukolj	Bor, republic environmental inspector
Ms. Ljiljana Stanojevic	Sabac, republic environmental inspector

Montenegro

Mr. Vasilije Buskovic	Ministry of Environmental Protection and Physical Planning (ministry coordinator)
Ms. Biljana Djurovic	Ministry of Environmental Protection and Physical Planning
Mr. Pavle Radoman	Podgorica / Niksic, republic environmental inspector

* With the adoption in Serbia of a new law on Ministries in February 2004, the Ministry for Science and Environmental Protection took over the tasks of the Ministry for Protection of Natural Resources and Environment.

Further information

Further technical information may be obtained from the UNEP Post-Conflict Assessment Unit website at:
http://postconflict.unep.ch


UNEP