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Global Environment Facility Transboundary Pollution Reduction in Three Danube Tributary Basins

Draft Final Project Report

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Metcalf & Eddy

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Section One

Section One
PROJECT OVERVIEW

Between September 1995 and March 2001, Metcalf & Eddy (M&E) and local subcontractors provided services to the United States Agency for International Development (USAID) to perform the Global Environment Facility Project for Transboundary Pollution Reduction in Three Danube Tributary Basins (GEF/Danube project).

Sponsored by the World Bank, the United Nations Development Program, and the United Nations Environment Program, the GEF was created in 1990 to address four global environmental issues: reduction of greenhouse gas emissions, protection of biodiversity, protection of international waters, and reduction of ozone layer depletion. The GEF/Danube project was part of the United States' $150 million contribution to the GEF.

The GEF/Danube project has achieved its objective of monitoring and reducing pollution transfer across three international boundaries: Slovakia/Ukraine, Hungary/Slovakia, and Hungary/Romania:

This project demonstrated how pollution can be reduced over the long term from key municipal wastewater plants and industrial plants. Project activities included:

- **Sponsored municipal wastewater treatment improvements** at Oradea in Romania and at Kosice in Slovakia
- **Established four automatic water quality monitoring stations** along three international boundaries
- **Assisted government agencies** in developing the institutional capacity and communications network to warn downstream users when pollution may threaten them
- **Assisted six Romanian industries** in adopting cleaner production techniques and in developing and implementing environmental management programs
- **Provided industrial wastewater treatment improvements** at industries in Romania

As Figure 1-1 shows, project activities met USAID strategic objectives for the three countries. This project completion report summarizes the major project activities and achievements.

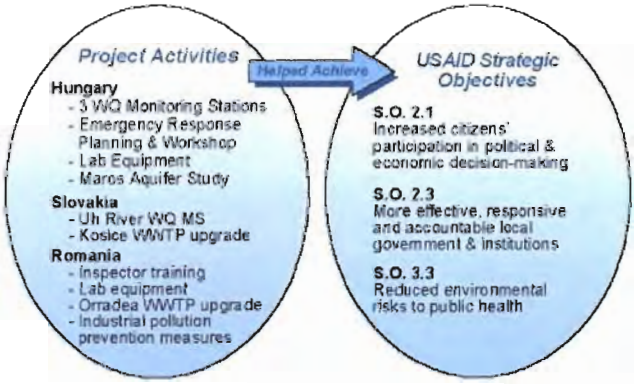

FIGURE 1-1. USAID STRATEGIC OBJECTIVES

1.1 BACKGROUND

The Danube River basin covers 817 square kilometers in Central Europe, including all of Austria, Hungary, Slovakia, Romania and Serbia, and parts of eleven other countries. Beginning at the Danube's source in the farmlands of western Germany, fertilizers, pesticides, and manure drain into the river system. Cities and towns discharge sewage into the river without treatment, and industrial discharges from smelters, paper mills, chemical plants, and tanneries have contaminated tributaries and water supplies.

Eight Danube countries, the European Commission, the United Nations, and international financing organizations established the Environmental Program for the Danube Basin, a multilateral program to strengthen and coordinate comprehensive environmental management across the entire basin. The Environmental Program created the Program Coordination Unit (PCU), located in Vienna, to oversee activities to be implemented in the Danube River basin countries.

As early as 1991, studies conducted through the Environmental Program identified sources of pollution in major Danube tributary systems. The thirteen Danube tributary countries affiliated with the PCU joined together in an international network through which they can alert each other when pollution incidents occur. Principal International Alert Centers (PIAC) were set up in each country to receive warnings of international transboundary pollution and relay those alerts to neighboring PIACs as well as to the PCU. Information on the type and severity of the pollution is disseminated to downstream receptors through a network of national, regional, and local telecommunications equipment. The PCU programs also establish monitoring, Laboratory Analysis, and Information Management (MLIM) standards.

The Accident Emergency Warning System (AEWS) associated with the monitoring in the GEF/Danube project is integrated with the international network of the thirteen Danube tributary countries affiliated with the PCU. Sampling, monitoring, and analytical methods developed in the project were in accordance with the AEWS and MLIM standards. Figure 1-2 shows how the AEWS operates at local, district, regional, and national levels.

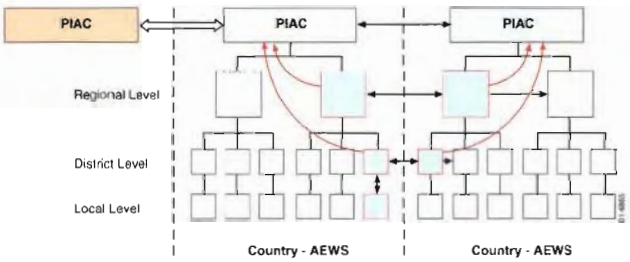

FIGURE 1-2. INTEGRATED OPERATION OF THE AEWS

1.2 PROJECT AREA

Figure 1-3 shows the three river basins with which the GEF/Danube project was concerned:

- Hornad/Hernad in Slovakia and Hungary
- Bodrog/Upper Tisza (including the Uh and Szamos/Somes) in Romania, Slovakia, and Hungary
- Cris/Koros (including the Berettyó) in Romania and Hungary

Rivers in these three basins carry pollutants into the plains of Hungary and into the Tisza, a tributary which joins the Danube in Yugoslavia. The GEF/Danube project addressed pollution in the Hernad, Uh, Szamos, and Berettyó rivers. The project also included a study to guide development in the watershed of a fifth river, the Maros. The map in Figure 1-4 shows the rivers in more detail. It also shows the locations of the various project activities.

Hernad/Hornad River Basin

The Hernad River (as it is called in Hungary) originates in Slovakia (where it is called the Hornad), and almost all of its catchment area is in Slovakia. Flowing south, it transports the discharge from municipal wastewater treatment facilities and mining and steel activities. The pollutants of concern include oil, cyanide, metals, phenols, formaldehyde, toxics, and pathogens. Two particular sources of pollution have been the Eastern Slovak Ironworks, a source of phenol, and the Kosice municipal wastewater treatment plant, a significant source of pathogens, nutrients, and other pollutants due to its partially treated effluent. The river quality at the Slovakia-Hungary border along the Hernad fluctuates between Class IV (polluted) and Class V (heavily polluted). This GEF/Danube project built and equipped a water quality monitoring station on the Hernad at Hernádszurdok in Hungary, 16.5 kilometers downstream from the border with Slovakia. The project also provided wastewater treatment improvements at the Kosice plant.

Bodrog/Upper Tisza Basin

The Uh River, with headwaters in Ukraine, flows through southeastern Slovakia, where it joins the Bodrog River as it enters Hungary. Ukraine has approximately 4,000 km of crude oil pipelines and 4,500 km of pipelines for petroleum products. The primary pollution problem in the Uh River is contamination from frequent oil spills (on average, two spills per year) from Ukrainian pipelines and fuel storage facilities. This discharge of crude oil and fuel travels across the Ukraine-Slovakia border

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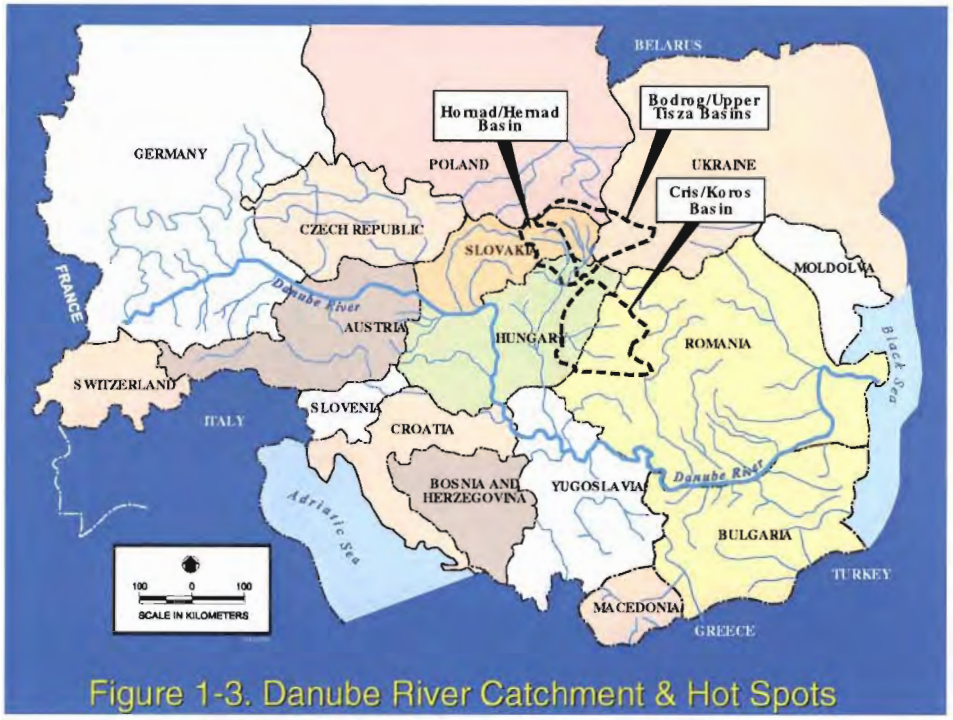

Figure 1-3. Danube River Catchment & Hot Spots

and into Slovakia. The contaminants continue to follow the course of the river and enter Hungary via the Bodrog River. The project built a water quality monitoring station at Levarovce, in Slovakia near the border with Ukraine.

The largest river in the upper Tisza/Tisa system, the Szamos/Somes, originates in Romania, and about 90 percent of its catchment area is in the Transsylvanian part of Romania. Contamination includes municipal wastewater effluent, industrial effluent, and agricultural runoff. The pollutants of concern include oil, metals, nitrates, phenols, toxics, and pathogens. The GEF/Danube project built a water quality monitoring station at Csengar, Hungary, at the border with Romania.

Cris/Koros Basin

The Berettyó/Barcau River originates in Romania, and about 90 percent of the catchment area is in the Transylvanian part of Romania. The Berettyó/Barcau transports a variety of pollutants from industrial sources, wastewater treatment facilities, and metal mining. However, the primary pollution problem on the Berettyó/Barcau River is oil spills. Between 1987 and 1995, at least 25 spills occurred. The largest (in 1995) required over 40 days of cleanup and spill containment, with 460 tons of oil removed. Downstream water use has been curtailed for an average of one week per spill event. The project worked with petroleum extraction and oil refinery industries in the area to help them minimize waste production and reduce industrial pollution to the Berettyó/Barcau.

The Rapid Cris River registered high levels of zinc, BOD, ammonia, and total phosphorous. Monitoring of the Rapid Cris in the Oradea area typically registered high levels of chromium. The project sponsored improvements at the Oradea wastewater treatment plant and also sponsored cleaner production and wastewater treatment improvements at pigment, pharmaceutical, and metalworking industries to reduce pollution of the Rapid Cris before it enters the Berettyó in Hungary.

The Black Cris River typically exceeded allowable thresholds for zinc, BOD, and ammonia and exceeded limits for copper in the vicinity of uranium mines and non-ferrous metal mines located on the Black Cris. The GEF/Danube project worked with mining industries in the area to reduce pollution to the Black Cris before it enters the Berettyó in Hungary.

The Barcau River water quality violated established standards for a variety of parameters, especially BOD and ammonia. The project worked with petroleum industries in the area to minimize their waste production and improve their environmental management practices.

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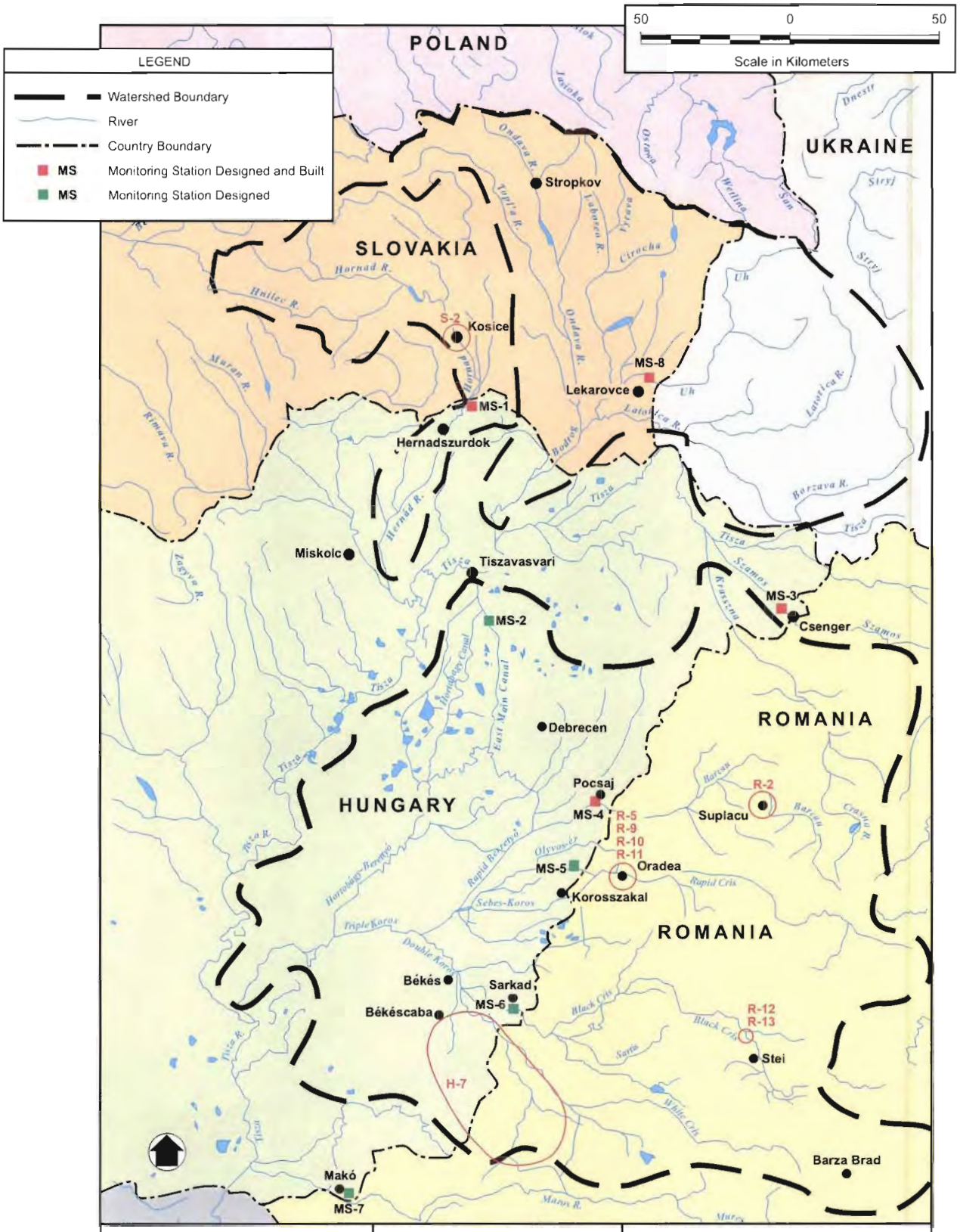

ACTIVITIES IN HUNGARY	ACTIVITIES IN SLOVAKIA	ACTIVITIES IN ROMANIA
MS-1 Hernard River at Hernadszvurdok	MS-8 Uhr River at Lekarovce	R2 Petrom, Petrolsub Petroleum Industries
MS-2 East Main Canal at Tiszavasvari	S2 Kosice Wastewater Treatment Plant	R5 Oradea Wastewater Treatment Plant
MS-3 Szamos River Station at Csenger		R9 Pigmenti Pigment Manufacturer
MS-4 Berettyo River at Pocsaj		R10 Chimprod Pharmaceutical Industry
MS-5 Kapid Koros at Korosszakal		R11 UAMT Metal Finishing
MS-6 Black Koros at Sarkad		R12 Uranium Mining
MS-7 Moros River at Mako		R13 SmBaita (Non-ferrous Metals Mining)
H7 Maros Aquifer		

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FIGURE 1-4. PROJECT ACTIVITIES IN THE CHRIS/KOROS HORNAD/HERNAD, AND BODROG/UPPER TISZA RIVER BASINS

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Maros River

The Maros/Mures River joins the Tisza at Szeged in southern Hungary. With over 90 percent of its watershed in Romania, the Maros/Mures transports a wide variety of effluent waste from chemical, mining, food processing, and other industries as well as from agriculture. The project conducted a study of the Maros aquifer, including the preparation and use of a hydraulic model, and developed a plan for protecting the aquifer.

1.3 PROJECT CHALLENGES

When the GEF/Danube project began, water quality monitoring, emergency response, and pollution prevention were hampered by limitations in physical infrastructure, under-funded institutions, competition with other pressing social problems for funding and priority, lack of environmental awareness and insufficient environmental monitoring capability. Although an international framework had been established for emergency response, facilities were not in place to allow Hungary, Romania, and Slovakia to participate fully in that system.

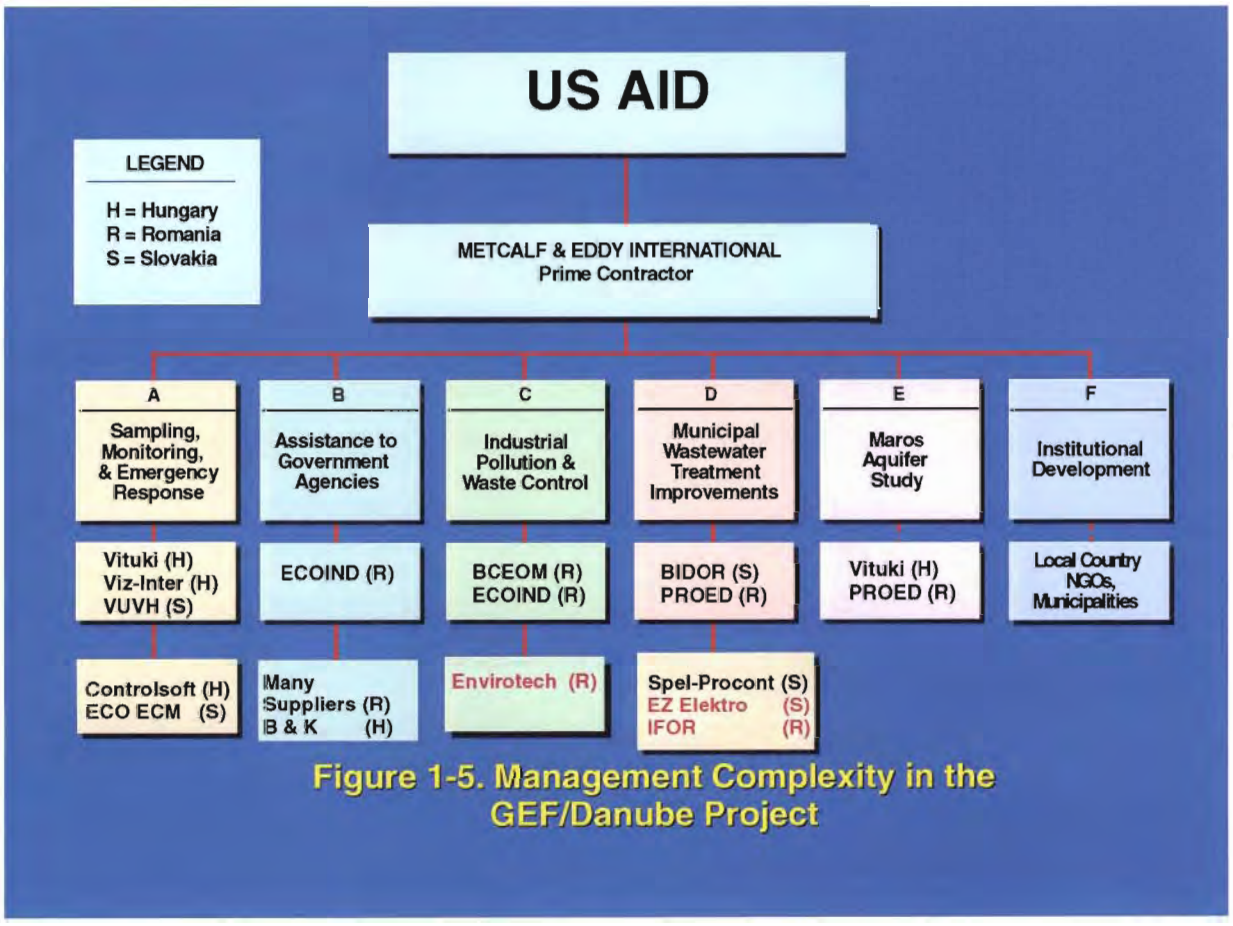

Figure 1-5. Management Complexity in the GEF/Danube Project

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Another challenge within the GEF/Danube project was the sheer complexity of managing over 20 smaller projects, employing 15 local subcontractors and many local suppliers, and interacting with multiple governmental and non-governmental entities in three countries and three different languages. Figure 1-5 shows the project organization and the primary subcontractors.

Additional challenges were posed by the need to renegotiate the Memoranda of Understanding (MOUs). These memoranda were negotiated between USAID and host countries between 1995 and 1997. Ironically, due to the extended time frames needed to execute the agreements, the scopes of services within the memoranda needed to change by the time the project actually got underway. The MOUs were signed by the environmental ministry of each country. However, since these commitments were not from the Ministry of Finance, and because these countries were in dire financial straits with many other pressing social and environmental problems, they were not able to allocate the funds USAID had anticipated.

Thus M&E had a two-fold challenge: (1) re-establish local priorities and obtain local commitment for the agreed-upon actions, and (2) find a local source for funding. M&E had to raise more than $2.5 million in local funds to implement the projects. Owners of wastewater treatment plants and industrial plants financed part of the work. Some had to obtain loans, and those efforts were time-consuming. Shared funding responsibility brought a high degree of local commitment, but it also meant that financial difficulties of the owners delayed completion of some improvements. Special measures were also needed to meet both local and USAID contractual requirements and to keep separately funded portions of an overall project coordinated but contractually separate.

1.4 PROJECT ACHIEVEMENTS

Specific Investments

- Constructed 4 water quality monitoring stations on international boundaries (Uh, Szamos, Berettyo, and Hernad Rivers)
- Improved laboratory capabilities for water quality testing in five of the 13 regions of Hungary and in Bihor Country in Romania
- Upgraded 2 wastewater treatment plants (Kosice and Oradea) to provide secondary treatment and partial nitrogen removal
- Constructed wastewater treatment and cleaner production improvements in six key types of Romanian industries

Training

- Trained 80 personnel representing these countries in emergency planning/response across international borders
- Trained 20 environmental inspectors in Bihor County, Romania in environmental enforcement and laboratory QA/QC

Industrial Culture Change

- Trained 25 industry managers Romania in cleaner industrial production approaches and development of environmental management plans
- Transferred knowledge of cleaner production technology to local industries
- Together with local environmental protection agency, implemented environmental management plans at six Romanian industries

Funding Innovations

- Obtained local cost-sharing and commitment from governments and industries
- Developed combined implementation plans for bidding and segregating costs into USAID and locally funded contracts. This resulted in a single general contractor cost, effectively implementing all work at each facility yet with separate contracts for USAID and locally funded work.

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Section Two

Section Two
PROJECT ACHIEVEMENTS IN HUNGARY

In Hungary, oil and nutrients pose the most serious threats to water quality. The Hernad River is subject to frequent algal blooms, the Szamos River is subject to both algal blooms and oil spills, and the Berettyo River has suffered 26 oil spills since 1987. To address these problems, the GEF/Danube project performed the following activities:

- Rehabilitated and/or constructed an automatic water quality monitoring station on each of these three rivers
- Designed four additional stations to be constructed at a later date
- Equipped laboratories to test water quality
- Trained local personnel in monitoring and emergency response
- Conducted a study of the Maros Aquifer

A letter of understanding was signed on October 21, 1996, by the Hungarian Minister of the Environment and Regional Policy, the U.S. Ambassador to Hungary, and the USAID representative to Hungary. This letter outlined the project's scope of services on Hungary and an implementation plan.

Subcontractors made significant contributions to the project work in Hungary. **Vituki Innosystem** provided planning, preliminary design, and final design for five water quality monitoring stations, three of which were constructed. The firm also helped organize a project-sponsored workshop on the AEWS emergency warning system and conducted the Maros Aquifer Study. **Viz-Inter** provided planning, preliminary and final design for two water quality monitoring stations, which have not yet been built. **Controlsoft** was the contractor for the USAID-funded construction of the three water quality monitoring stations.

Figure 2-1 Szamos River Station (MS-3), at Csengar

2.1 WATER QUALITY MONITORING STATIONS

Table 2-1 summarizes the pollution problems in the Hungarian rivers on which the GEF/Danube project built automatic water quality monitoring stations.

Figure 2-2 Hernad Station (MS-1)

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TABLE 2-1. WATER QUALITY PROBLEMS - HERNAD, SZAMOS, AND BERETTYO RIVERS

Monitoring Station	Primary Problems	Sources	Major Users
Hernad River Station (MS-1, at Hernadszurdok)	Nutrients (Algal blooms noted, dissolved oxygen low) *History:* 1986. Chernobyl nuclear accident resulted in increased radioactivity for two months. 1991 – 1997. River quality at border fluctuates between Class IV (polluted) and Class V (heavily polluted).	Eastern Slovak Iron works Kosice WWTP Domestic settlements, mining, industry, agriculture, and transportation	*Surface:* Power stations Agricultural irrigation Sport fishing Water sports, recreation *Subsurface:* Water supply
Szamos River Station (MS-3, at Csengar)	Algal blooms during summer low flow months, depleting the river of dissolved oxygen.	Municipal WW facilities Industrial effluent Agriculture	Irrigation for cooperatives Recreation at beaches Water supply
Berettyó River Station (MS-4, at Pocsaj)	Oil Spills *History:* 1987: 10 oil spills, low volume but user disruption 1988: 6 oil spills 1989: 4 oil spills 1990: 1 oil spills 1992: Major spill required 8 days of cleanup & spill containment 1993: 3 occurrences. Fish kill observed 1995: Largest spill ever. Over 40 days of cleanup & spill containment. 460 tons of oil removed.	Oil wells Refineries Oil storage	Primarily irrigation, but also bathing, fish farming, groundwater uses, swimming, recreational fishing, industry

To make use of existing river gaging facilities, the GEF/Danube project elected to rehabilitate existing flow monitoring stations in Hungary and add additional capabilities to monitor water quality and point sources over time. The Hernad River Station was constructed at Hernadszurdox; the Szamos River Station was constructed at Csenger; and the Berettyo River station was constructed at Pocsaj.

Because the letter of understanding did not include any local spending, one of the first challenges of the project was to convince local authorities to fund infrastructure-related improvements at the existing monitoring stations. To implement the agreed-upon cost sharing with local authorities, VITUKI prepared two different tender documents, one for the civil works, and one for the equipment installation. At all three stations, civil works and telecommunications connections were financed by the Ministry of Environment, and the equipment and data transmittal facilities were financed by USAID.

Total investment by USAID for the three monitoring stations was $467,600, and the total investment by Hungary for civil improvements was approximately $100,000.

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At all three, the project installed sampling stations and installed new water quality instrumentation, including basic instrumentation for dissolved oxygen, pH, conductivity, and turbidity. Additional analysers included ammonia, chlorophyll A, and TOC (surface, subsurface). An automatic sampler and accidental emergency warning system equipment were provided, and communications networks were established among the local water directorates and the local environmental inspectorates.

Renovations included work to improve the existing buildings, such as replacing roofs and windows, as well as work related to the monitoring functions, such as constructing new intake structures and pipelines.

The three stations were completed in the fall of 1999. After a trial operating period from late 1999 until March 2000, the monitoring stations were officially transferred to local inspectorates. Figures 2-4 and 2-5 show typical data gathered during the initial months of operation.

The monitoring stations measure selected water quality parameters and forward the information to regional telemetry centers. The stations operate automatically, without the presence of an operator, though local and remote control are possible. Certain test results automatically initiate alarms and alert others in the emergency warning network. The equipment is also used to track water quality during and after emergencies.

2.2 EMERGENCY RESPONSE TRAINING AND NETWORK

In conjunction with renovating and equipping the three monitoring stations, the GEF/Danube project trained personnel to operate these stations and fostered cooperation and communications among agencies to improve transboundary emergency planning and response.

The urgent need for an effective transboundary emergency response system was illustrated powerfully by a cyanide spill in Romania in February 2000, shortly before the Hungarian monitoring stations downstream began operation. A dam broke at a gold mine in northwest Romania, near Oradea. A cyanide solution is used at the mine to separate gold from the surrounding rock, and the waste rock or tailings were stored behind the dam. When the dam broke, cyanide poured into streams

Figure 2-3 Szamos River Sample Point (near MS-3)

which flowed west into the Tisza in neighboring Hungary, killing large numbers of fish, and then flowed into Yugoslavia and Serbia. The cyanide posed a risk to wildlife and to people who use the water from wells near the riverbed. Had the monitoring stations been operative at that time, downstream users would have received faster notification and would have been able to act sooner to take protective actions, such as closing off irrigation and potable water canals. Automatic monitoring of Chlorophyll A would have given an indirect measure of toxicity.

In March 2000, USAID sponsored a two-day workshop in Miskolc. Vituki Innosystem helped organize the workshop. The 80 participants included representatives of environmental inspectorates, water directorates, ministries, and nongovernment organizations from all three countries. Participants welcomed the opportunity to discuss the recent cyanide spill and resultant fish kill with officials from other countries. Representatives from the DAEWS explained the overall warning system and the roles of the alert centers. The workshop also addressed how the three monitoring stations would be integrated with the overall system. Figure 2-4 shows this integration. Participants also discussed an action plan presented by VITUKI, local emergency response plans, and communications issues. Participants also visited the Hernad monitoring station.

This infrastructure and communications network enables officials in Hungary, Slovakia, and Romania

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Figure 2-4. Clorophyll-a concentration (ug/l) in Hernad River, May 5-June 11, 2000

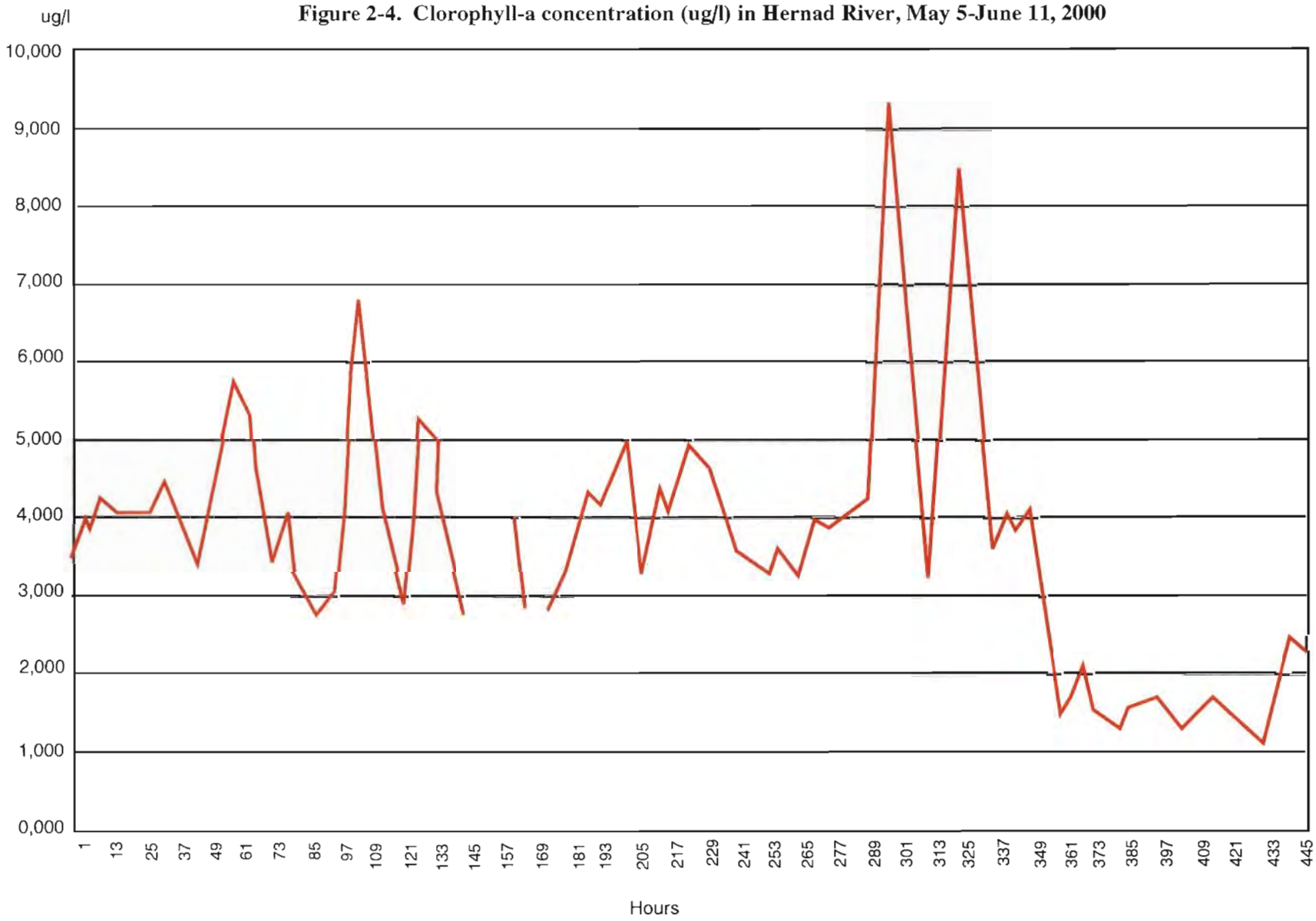
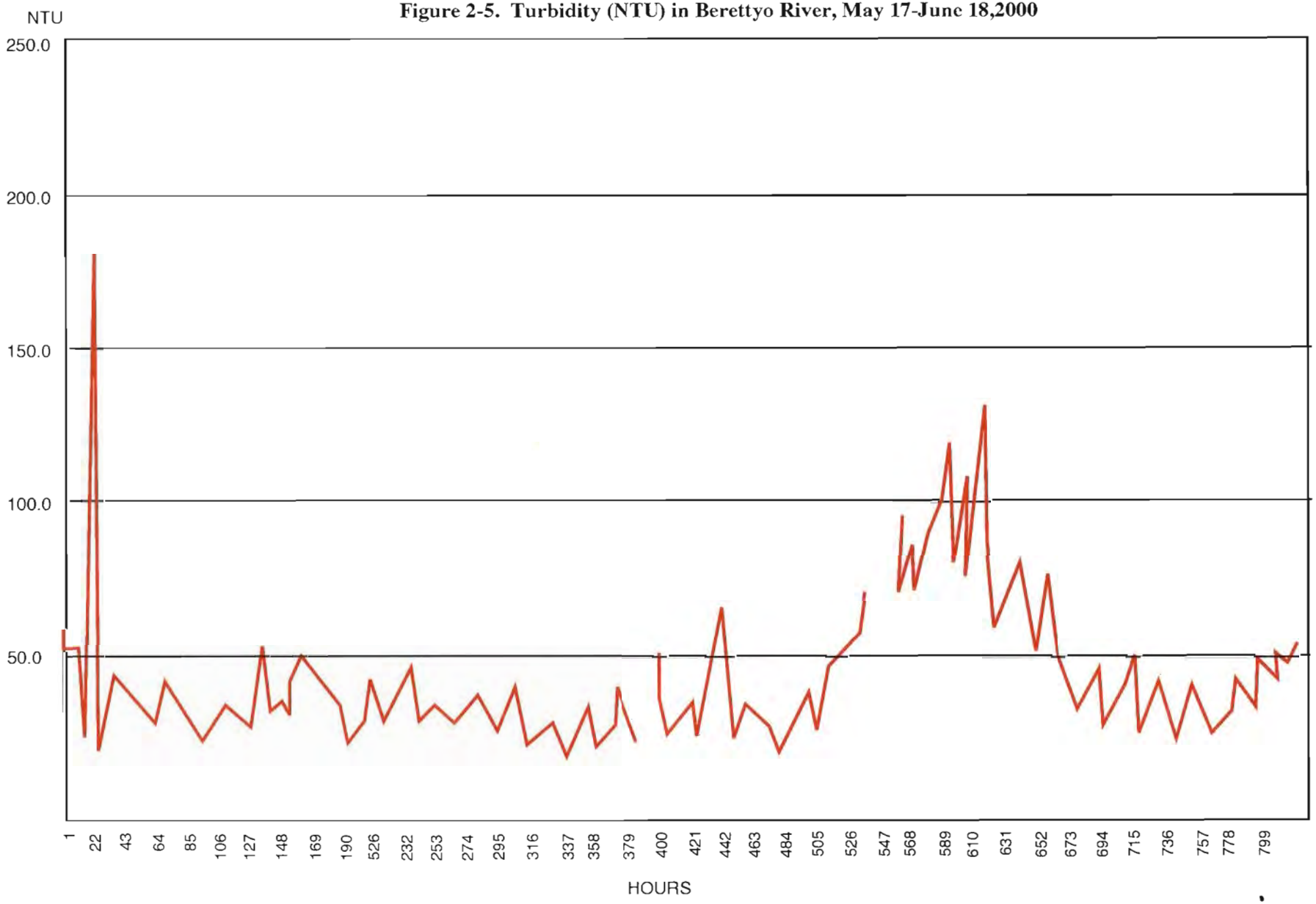


Figure 2-5. Turbidity (NTU) in Berettyo River, May 17-June 18,2000



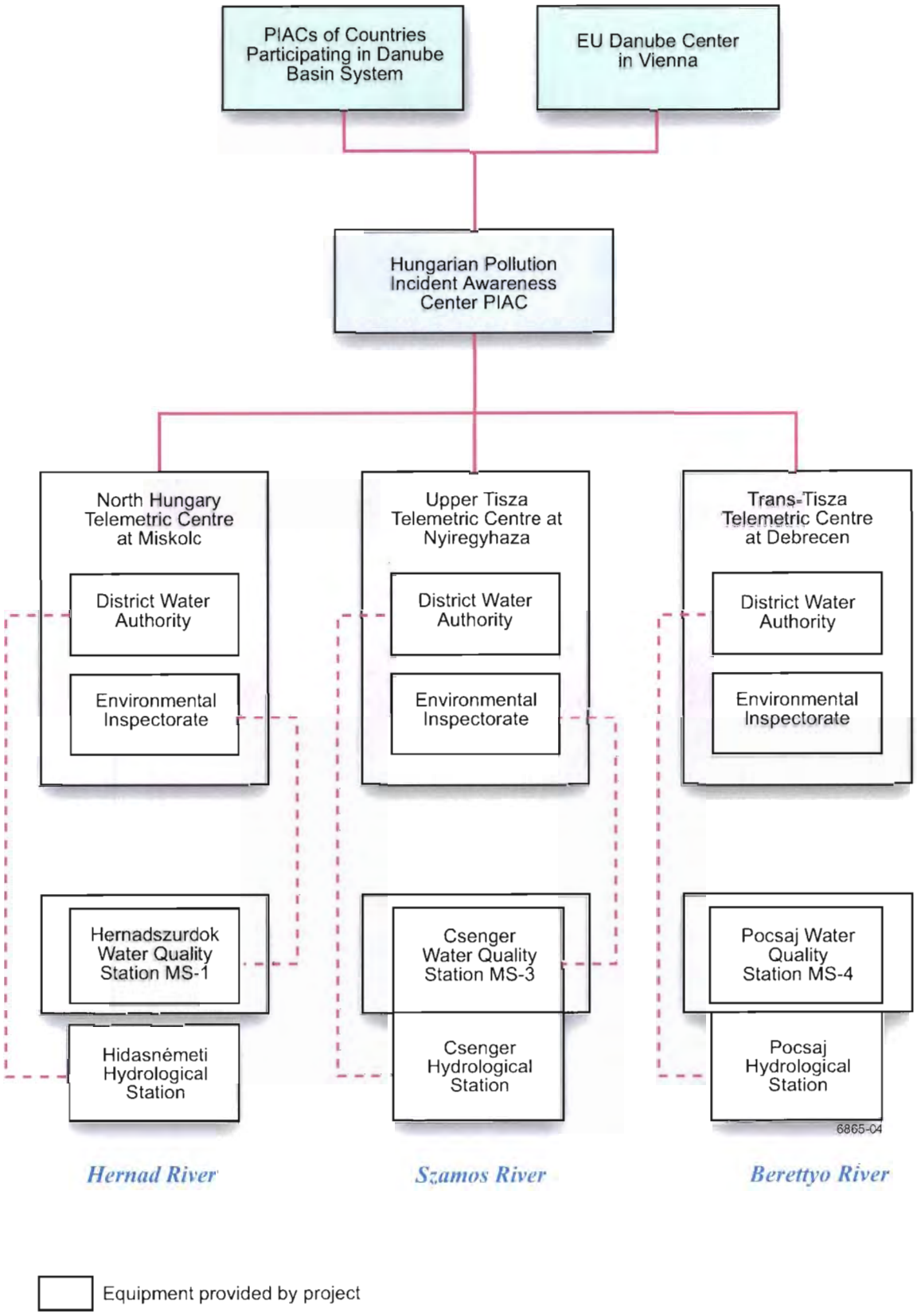


FIGURE 2-6. NEW MONITORING SYSTEM AND INTERCONNECTION

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to alert people within and across national boundaries when river pollution occurs. When people are alerted that an accidental release of pollution has occurred upstream, they can alter or discontinue their use of the contaminated river water until the threat has dissipated or has passed the users' supply intakes.

2.3 LAB EQUIPMENT

To assist Hungarian environmental agencies in monitoring the rivers, the project team met with them to assess their equipment needs and develop a set of priorities. The GEF/Danube project procured water quality laboratory equipment for the following five regional environmental inspectorates in Hungary:

- Gyula
- Debrecen
- Nyiregyhaza (associated with the Csengar monitoring station)
- Szeged
- Miskolc (associated with the Hernad monitoring station)

The following types of equipment were provided:

- Gas chromatograph
- Portable samplers
- Balances, desiccators
- Distilled water units
- Replacement AA lamps
- Incubators

This equipment will allow the regional inspectorate laboratory to better accomplish their mission of monitoring discharges and stream water quality.

The total USAID investment for the laboratory equipment and a vehicle to service the three new water quality monitoring stations was $149,000.

2.4 MAROS AQUIFER STUDY

The Maros Aquifer straddles the Romania/Hungary border, and transboundary pollution has the potential to occur through groundwater movement. Local subcontractor VITUKI, with assistance from M&E's Romanian subcontractor PROED, carried out a study of the Maros Aquifer, to obtain information to help protect it. This study summarized existing studies, defined the primary sources of pollution in Romania and Hungary, and defined water users and their locations in Hungary. Vituki prepared a regional hydraulic model of the aquifer, using Modflow, which show water quality and the quantity of withdrawals. It also simulated changes that would occur under various future conditions. During the summer and fall of 1999, the shallow surface aquifer was sampled for pesticides and organic solvents at 15 sites in Romania and 11 in Hungary.

Note: The project assisted in developing possibly the first inter-county transboundary agreements between Arad and Bekes Counties. These agreements regarding the aquifer are still under review. Bekes County is in Hungary, and Arad County is in Romania.

Study Findings

The study found that pollution from agricultural pesticides application in the region is moderate. The other types of analyzed organic micropollutants (volatile and semi-volatile aromatics, volatile chlorinated hydrocarbons) were found in insignificant concentrations. The nitrate concentrations are below 20 mg/l in the production wells. Higher nitrate concentration can be found in the shallow phreatic groundwater which is the recharge source of the deeper groundwater only in some regions of the study area.

The very long vertical travel times of the infiltrating water and pollutants in the dominant part of the study area mean low vulnerability for the aquifer. The area where the vertical travel time is less than 50 years is 40 km^2 or less.

Study Conclusions

The study concluded that the Maros aquifer can provide good quality groundwater appropriate for drinking water supply but that a formal protection program is needed. Vituki developed a program that allows activities in the surface and subsurface zones if they do not affect the quality or quantity of existing or planned sources and if they do not interfere with extraction of the water. The program also includes recommendations regarding future land use in the hydrological safety zone, within which the travel time to the point of extraction is less than 50 years.

Section Three

Section Three
PROJECT ACHIEVEMENTS IN SLOVAKIA

In Slovakia, the primary issues addressed by the project were water quality problems in the Uh and Hornad Rivers (See Table 3-1). The Uh River faces pollution from oil-related industries upstream in the Ukraine, and the Hornad is polluted largely by incomplete wastewater treatment at Kosice.

To help local officials alert downstream users when pollution is accidentally released into the Uh River, the GEF/Danube project:

- Built a shelter and provided equipment for a monitoring station on the Uh River
- Provided training and networking for emergency planning and response

To improve water quality in the Hornad River and thereby reduce threats to public health, the project:

- Made improvements to the Kosice wastewater treatment plant

A letter of understanding was signed on August 19, 1996, by the Slovak Ministry of the Environment, the American Ambassador to Slovakia, and the USAID representative to Slovakia. The letter outlined the scope of and implementation plan for project activities in Slovakia.

Water Research Institute (WRI) provided planning and design for the water quality monitoring station. ECM/ECO Monitoring supplied and installed the instrument shelter and the water quality monitoring instruments.

BIDOR performed the planning and engineering for improvements at the Kosice wastewater treatment plant. Spel-Procont supplied and installed the plant's computer process control equipment. EZ Electro Monitoring Systems performed the electrical improvements at the plant.

Figure 3-1. Uh River, upstream of MS-8 Station

3.1 UH RIVER WATER QUALITY MONITORING STATION

The Uh River in Slovakia flows south, joins other streams, and eventually discharges into the Bodrog River before crossing the Slovakian border into Hungary. In Hungary it joins the Tisza and then the Danube. The GEF/Danube project modified an existing bridge for utility pipelines and retrofitted a new instrument shelter, water quality instrumentation, and communications equipment. This new monitoring station is located on the Uh River at Pinkovce, approximately three kilometers downstream from the eastern border with the Ukraine. Slovakia contributed approximately $25,000 for civil improvements such as a new access walkway and instrument platform as well as electrical connections. The investment by USAID was $139,538.

GEF/Danube project staff worked with the Slovak Ministry of the Environment, the Slovak Inspectorate for the Environment, the Slovak Hydrometeorological Institute, local inspectorate officials, and our subconsultant, Water Research Institute, to establish locations and criteria for

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TABLE 3-1. WATER QUALITY ON THE UH AND HORNAD RIVERS

River	Problems	Remarks	Uses
Uh River (monitoring station MS-8)	Frequent oil spills from Ukranian pipelines. Reported average of two per year. Pollutants of concern include petroleum products, phenols, nitrates, toxins, pathogens, PCBs.	Other Ukranian industries also contributed to pollution due to outdated equipment and improper disposal. Chernobyl/accident also contributed to problems (radioactive materials from plume seeped into groundwater)	Water supply Irrigation Bathing Fishing Well recharge
Hornad River	Oil, cyanide, metals, formaldehyde, toxins, and phenols pollute the river	River quality at the Slovakia/Hungary border fluctuates between Class IV (polluted) and Class V (heavily polluted)	Irrigation Recreation Bank-filtered well water, for drinking Subsistence and recreational fishing

sampling. As Table 3-1 indicates, principal pollutants of concern in the Uh River include petroleum, petroleum products, and nutrients. The GEF/Danube project provided instrumentation to monitor water quality in terms of temperature, pH, ORP, conductivity, dissolved oxygen, turbidity, NO_3, NH_4, and oil on the surface. Staff was trained in using the equipment.

The monitoring station includes:

- Continuous on-line petroleum monitor affixed on the tube bridge over the river
- 11.5-m long loosely suspended steel protection tube for water quality sampling
- Steel platform anchored into the concrete pillars of the tube bridge
- Electric connection from the municipality Pinkovce
- Steel footbridge situated between the tube bridge and dike
- Radio link to local water plant

The GEF/Danube project also provided the following communications equipment at the water treatment plant in Lekarovce:

- Computer for local alarm annunciation and water storage for water quality monitoring
- Link to mobile phone network and local offices of the system operator at the Slovak Hydrometeorological Institute
- Satellite relay to Bratislava PIAC

Satellite communication is with the Slovak Inspection of the Environment Department of Water Management Inspection Headquarters, Bratislava (SIE dpt. WMI – PIAX 04 SLOVAKIA).

The monitoring station and early warning system will benefit the area in several ways. Continuous on-line petroleum monitoring will detect refined petroleum products, solvents, and crude oil on the water surface. When the warning system reports advancing petroleum pollution, water pumping from downstream irrigation and drinking water supply wells can be interrupted. This action will help protect groundwater resources and surface waters downstream, in East Slovakia and Hungary. This partial protection against the infiltration of petroleum substances into drinking water wells can safeguard the public against health hazards from contaminated drinking water.

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3.2 KOSICE WASTEWATER TREATMENT PLANT IMPROVEMENTS

The discharged effluent from the wastewater treatment plant in Kosice violates permitted discharge standards, including biochemical oxygen demand (BOD), total suspended solids (TSS), and ammonia. After 2004, the permitted effluent concentration limits will become more stringent. Compliance with these new, more stringent standards would not be possible without the implementation of this program. The GEF/Danube project goal was to assist in the improvement of treatment efficiency and capacity to bring the effluent into compliance with the 2004 discharge standards, thereby improving water quality downstream.

Figure 3-2. Mothballed equipment and piping at Kosice prior to GEF/Danube project

Figure 3-3. New instrument wiring to motorized gates to fine-screen influent channels

The Kosice wastewater treatment plant is operated by the Eastern Slovak Water Company (VVAK). The original treatment plant for Kosice city and the Eastern Slovak Ironworks was put into operation in 1964. The plant had a design capacity of 60,000 m^3/d and a design population of 200,000.

Construction of a new wastewater treatment plant, located adjacent to the older wastewater treatment plant, began in 1985. The new plant was designed for 112,320 m^3/d and a population equivalent of approximately 400,000. However, due to lack of funding, construction of the new plant was stopped before it was completed. A failed digester resulted in a sludge spill in 1994, causing dramatic water quality impacts in the Hornad River.

The GEF/Danube project, as initially envisioned, was to replace the failed digesters and provide sludge handling and digestion capabilities to accommodate expected higher sludge production from the new treatment plant. However, because of delays in the GEF/Danube project (discussed above in Section 1), VVAK independently constructed new digester tanks and dewatering facilities, including a sludge handling and digestion system and four sludge holding tanks.

In 1997, the new anaerobic digesters were completed and put into operation along with the primary clarifiers in the new wastewater treatment plant. The effluent quality improved, but the discharged effluent was still not in compliance with permitted standards. Completion of the secondary treatment facilities was an urgent priority for VVAK, because one third of the plant's effluent was not receiving secondary treatment. The GEF/Danube project, together with VVAK, developed a two-step program to provide full treatment of all wastewater at the Kosice wastewater treatment plant:

- **Biological treatment completion.** Funding to complete the entire new Kosice treatment plant was beyond both the financial scope of VVAK and the GEF/Danube project. However, financial resources were sufficient to finish a portion of the new plant, a portion sufficient to fully treat the one third of the influent wastewater flow that was being bypassed to the Hornad River after partial treatment. Thus in a combined effort with VVAK, construction of four aeration basins, one sludge aeration tank, two secondary clarifiers, return sludge pumping, aeration blowers, and all associated mechanical, piping, and electrical

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facilities were accomplished. The result was the capability for full secondary treatment of all influent wastewater at Kosice, with the added benefit of partial nutrient removal.

- **Control System modernization.** This system consisted of a programmatic logic controller (PLC) system, including new field wiring, new instrumentation/operations cabinets in the process area, and a data highway. The project supplied new instrumentation/control stations in the following areas: mechanical treatment, sludge storage, digester, biological treatment; dispatching center, laboratory, and engineers center work station.

  The installation of the instrument and control system improves the control of the plant by enabling the operator to observe the current operating status of the plant equipment regardless of weather conditions. The system detects mechanical failures, which could result in the release of untreated or partially treated wastewater to the Hornad River. Water quality indicators such as dissolved oxygen, pH, and ammonia are also monitored by the new control system. The monitoring of these parameters enables operators to adjust the flow of the aeration system according to the strength of the wastewater. The manual intervention of the aeration flow system results in optimum power consumption due to the reduction in flow under diluted wastewater conditions.

Benefits

The present average daily flow reaching the plant is about 1300 L/s. Of this amount, 870 L/s is directed to the old activated sludge plant, where it receives secondary treatment. Effluent averages 12.3 mg/L BOD and 11 mg/L TSS. These values are well below the current standards: 30 mg/L BOD and 25 mg/L TSS.

The remainder of the flow – 430 L/s – is directed to the primary clarifiers of the unfinished new plant, where it receives primary treatment. Effluent averages 65 mg/L BOD and 60 mg/L TSS.

When a portion of the new plant is on line, approx. 850 L/s will continue to be directed to the old plant, where it will receive secondary treatment. The remaining flow of 450 L/s will be diverted to the activated sludge portion of the new plant. This flow will receive secondary treatment, and nitrogen and phosphorus removal. The expected effluent would be 10 mg/L BOD, 20 mg/L TSS, 2 mg/L ammonia, 8 mg/L total nitrogen and 1.5 mg/L phosphorus. The overall benefits of the Kosice WWTP improvement are summarized in Figure 3-5 for the new plant. By providing secondary treatment for the one-third of the plant's influent wastewater that was bypassed, dramatic improvements in discharge effluent quality are achieved. Effluent quality improvements in the secondary treated effluent from the new plant include an 83% reduction in BOD_5, 74% reduction in COD, 70% reduction in TSS, 59% reduction in total nitrogen and 43% reduction in total phosphorus.

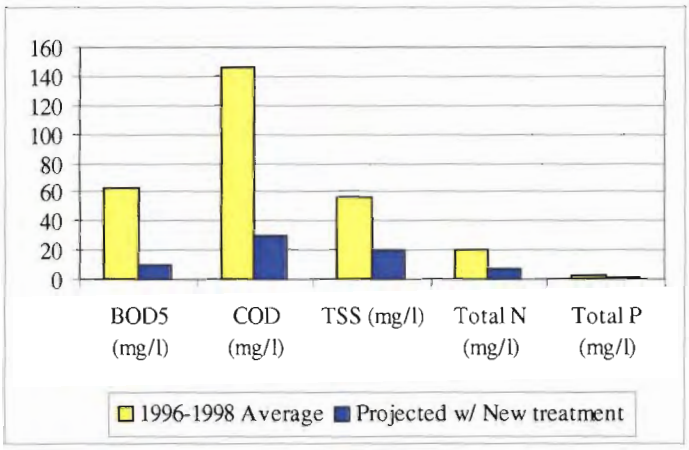

Figure 3-5. Projected Improvement in Effluent Quality at the New Section of the Kosice WWTP

This project is an excellent case study in the benefits of cost sharing with local partners. The Eastern Slovak Water Authority provided $1,089,000 for mechanical improvements and to complete the biological treatment process. USAID provided $584,000 for the plant-wide control system modernization and $605,125 for electrical work associated with the biological treatment completion. Altogether, USAID contributed $1,189,125.

Section Four

Section Four
ROMANIA – CHALLENGES AND ACHIEVEMENTS

In Romania, industrial sites and municipal treatment plants near Oradea in Bihor County were significant contributors of pollution within the Danube tributary basin. Table 4-1 outlines the water quality problems in the Cris River basin.

As shown in Figure 4-1, Bihor County is located on the western border of Romania on the Hungarian border.

A letter of understanding was signed between the Romanian Minister of Water, Forest, and Environmental Protection, the U. S. ambassador to Romania, and the USAID representative to Romania on November 24, 1997.

GEF/Danube project activities within Bihor County included:

- **Government assistance.** The project provided training in the fundamentals of environmental regulatory inspection and quality control and assurance for water quality laboratories. Financial assistance was also provided for procurement of critical laboratory equipment. These actions will result in improved regulatory monitoring by the regional environmental protection and river basin management agencies.
- **Municipal wastewater treatment improvements.** The project also upgraded the Oradea wastewater treatment plant, thereby reducing pollution to the Rapid Cris River and lowering pollution transfer across the international border with Hungary.
- **Industrial pollution reduction and waste minimization.** The project worked with six industries to improve their environmental management, pollution prevention, and wastewater treatment facilities, and thus greatly reduce the pollution from their operations. Changing the existing attitudes towards environmental protection, as evidenced by the collaborative funding for these industrial projects, was a major achievement of the project.

Figure 4-2. Oradea WWTP - New Primary Effluent Pump Station

Subcontractors made significant contributions to the work in Romania. BCEOM, a French environmental consulting firm, assisted with planning on the industrial tasks and spearheaded the project's cleaner production efforts. ECOIND (formerly ICPEAR), a Bucharest based environmental services firm, assisted with planning, design, and implementation of the industrial wastewater treatment improvements, assessment of regulatory, industrial and municipal environmental monitoring needs, laboratory equipment procurement, and training for laboratory QA/QC and environmental inspections. PROED, a Bucharest consulting engineering firm, provided preliminary and final design for the municipal treatment plant at Oradea.

4.1 GOVERNMENT ASSISTANCE

Background

The two government agencies with which the project worked are the Bihor County branch of the Agentia de Protectia Mediului (the Romanian environmental protection agency, APM) and the river basin

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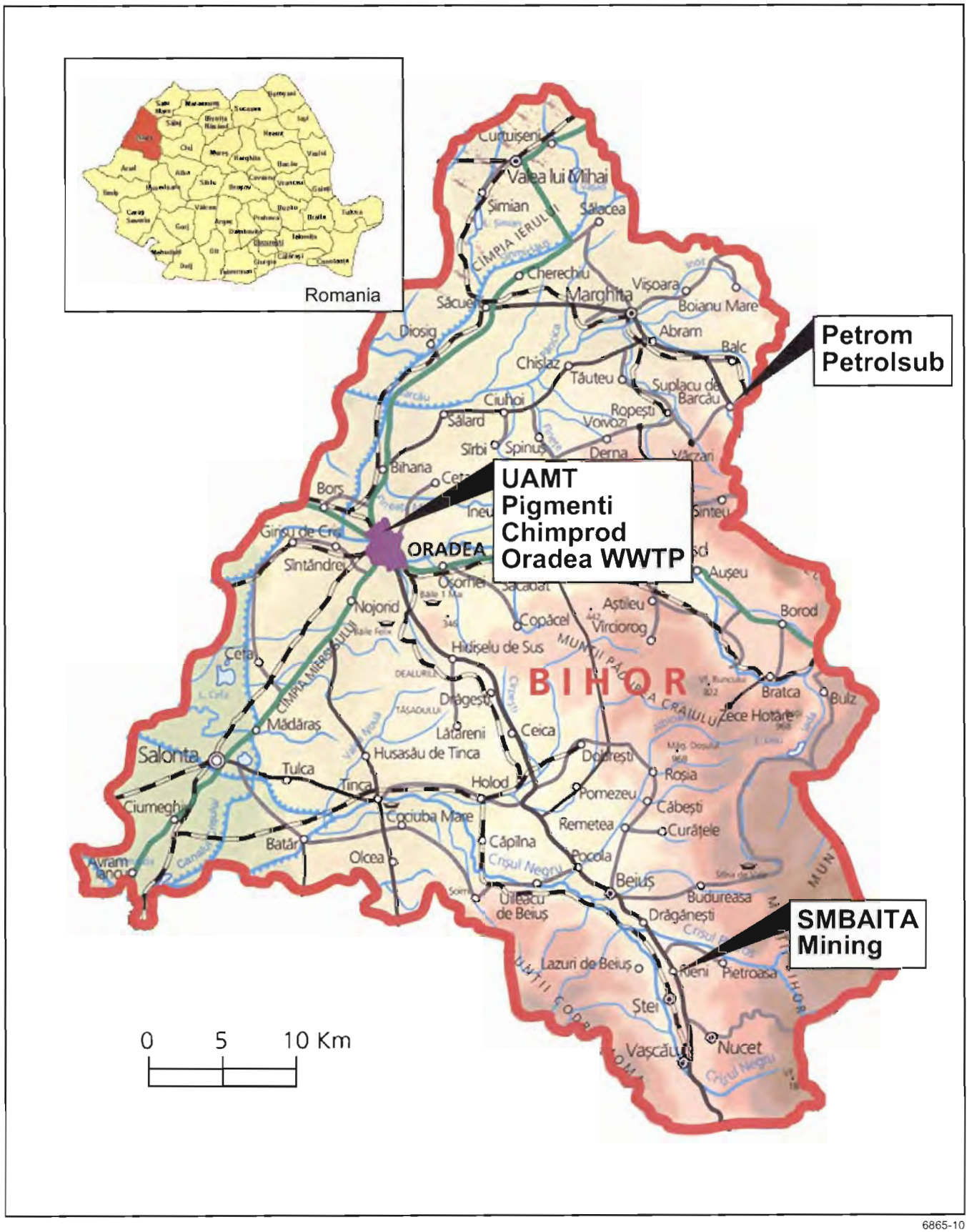

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FIGURE 4-1.
SITES OF PROJECT ACTIVITIES IN BIHOR COUNTY

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TABLE 4-1 WATER QUALITY ISSUES IN THE CRIS RIVER BASIN

River	Source	Pollutants	Users
Rapid Cris	OradeaWWTP Pigment, pharmaceutical, metal works industries	Chromium Zinc BOD Ammonia Total phosphorus	• Irrigation • Commercial and sport fishing • Shallow well recharge (potential)
Black Cris	Uranium mines Non-ferrous metal mines	Zinc BOD Ammonia, copper	• Irrigation • Commercial and sport fishing • Shallow well recharge (potential)
Barcau	Petroleum production facilities Crude oil refineries	BOD Ammonia Other parameters	• Irrigation • Commercial and sport fishing • Shallow well recharge (potential)
Remarks	• 1992-94 World Bank study reported that 64% of the Cris River system violated water quality standards • Rapid Cris demonstrated the poorest water quality • Over 90% of water users in the Cris River basin rely solely on these surface waters • Industries diluted wastewater to meet permitted thresholds • Oradea municipal WWTP discharged partially treated wastewater containing pathogens and toxic compounds		

commission, Apele Romaine. These agencies are responsible for inspecting and monitoring the discharge from the industrial and municipal facilities identified as significant contributors of pollution to the Cris Basin. Key priorities of these agencies were to train their staff better and modernize their laboratory support capabilities.

Goal

The reason for strengthening the capabilities of regulatory agencies in the Oradea area was to help them monitor environmental compliance more effectively in both the industrial and municipal sectors. More effective environmental regulation together with improved self monitoring by industry are basic building blocks towards the long-term goal of achieving compliance with Romanian standards for discharged effluent.

Project Activities

Project activities were organized into three overall efforts: strengthening governmental environmental agencies in Bihor County; improving government laboratory quality assurance and quality control; and modernizing laboratory equipment.

Stronger Inspection Training. To begin the inspector training, experts from ECOIND worked together with inspection teams from APM to conduct inspections at 10 major industries in the Oradea area. This was followed by two sets of inspector training sessions organized by M&E and ECOIND. This training was based on US EPA practices but tailored to the Romanian reality. Part One was given on July 14 to 15, 1998 and Part Two on August 4 to 6, 1998. The training was conducted for the inspectors of APM Oradea, Apele Romaine, the Oradea Municipality, the Public Health Inspectorate (Sanitary Police), and the Oradea WWTP. All training was conducted in Oradea.

The inspection courses were tailored to the needs of Romanian environmental agencies, beginning with methodologies and practice described in several US publications, including the USEPA Compliance Inspection Manual. The fundamentals and experience with compliance inspections were mixed with interactive exercises in which inspectors worked together to solve their inspection problems efficiently and effectively. Following the presentation on inspection procedures, experiences, and learning related exercises, the inspectors successfully developed their own inspection exercise, which was conducted at S.C. ALOR, S.A.

in Oradea. This inspection was completed in almost half of the time presumed by the present methodology, and the inspectors used lessons learned to develop an excellent set of recommendations. These were included in their inspection report and presented to ALOR's President and technical directors at the closing meeting of the real inspection exercise.

Special training sessions were dedicated to demonstration and use of field instruments (photometers, pH meters, and individual colormetric test kits.) Both the July and August training sessions were covered by local newspaper and television media.

Laboratory QA/QC Training. ECOIND inspected laboratories in Romania and then developed and delivered a training course for laboratory staff, for the purpose of improving the QA/QC in analytical laboratories.

ECOIND inspected laboratories of APM, Apele Romane, the water treatment plant, the Oradea Wastewater Treatment plant, and several industries (Sinteza, Pigmenti, and UAMT). ECOIND evaluated the equipment status, the expertise of the personnel, and the QA/QC methods being used. ICPEAR then identified the equipment and training needs.

ECOIND used the information gathered in the laboratory inspections to develop a training manual and a two-day training session, specifically tailored for these laboratories. The manuals reflected both European and U.S. methods and standards and covered the following topics:

- Introduction to quality management
- Laboratory accreditation standards and bodies
- Water analysis legislation and standards
- QA in testing
- QC in testing
- Sampling techniques, sample pretreatment, preservation, and handling
- Analytical control – chemical and instrumental methods
- QA/QC for field monitoring equipment

The topics were covered by presentations, discussions, and group exercises.

A special session was allocated to QA/QC for field instruments. In response to participants' interest, equipment distributors were invited to present information at the coffee breaks.

Delivered in Oradea, the session was covered by local newspaper and television media. The 22 participants - from APM, Regia Apele Romane, the Public Health Inspectorate, the Oradea Wastewater Treatment plant, several industries (Sinteza, Pigmenti, and UATM), the municipality, and the Oradea Environmental University – received certificates.

Laboratory Equipment. Approximately $80,000 of laboratory and monitoring equipment was delivered to the APM:

- Atomic adsorption spectrometer (AAS)
- Colorimeter
- Computer
- Vehicle
- Portable sampler and flowmeter
- Portable water quality analyzers (pH, DO) and photometer type test kits for cyanide & heavy metals
- Portable air quality analyzers (CO, COV, & SO2)

In addition to the investment at APM, approximately $72,000 of laboratory equipment was provided for Apele Romaine. This investment furnished Apele Romaine with an atomic absorption spectrophotometer with a graphite furnace. The graphite furnace provides a lower detection level for metal analysis that is needed by Apele Romaine for their mission of monitoring river and stream water quality within Bihor County.

Results

Inspector Training Results:

- Greater efficiency in inspection procedures, methods, and reporting, such as through incorporation of checklists and questionnaires
- Greater effectiveness through use of portable instruments, such as by incorporating monitoring results into discussions during inspections and using them on the spot to develop solutions
- Firm commitment by inspectors to recommend and enforce pollution prevention and control

- Better communication and cooperation between inspectors and laboratory staff, agencies, and officials
- Development of integrated environmental policy
- Heightened staff interest in further training, to assist APM/Oradea in assuming leadership among Romanian agencies

Laboratory Staff Training results:

- Improved QA/QC methods in laboratories
- Improved communications among various laboratories
- Better cooperation between laboratory staff and inspectors
- Development of integrated (government and private labs) QA/QC policy
- Heightened staff interest in improving laboratory QA/QC, to achieve laboratory accreditation
- Heightened staff interest in further training, to improve their own skills and knowledge and assume leadership in Romanian environmental laboratories
- Heightened staff interest in scientific and technical information

4.2 ORADEA WWTP IMPROVEMENTS

Background

The Oradea Wastewater Treatment Plant is on the banks of the Rapid Cris River, approximately 1.5 km downstream and west of Oradea. Sewer pipes in Oradea collect both separate sewer flows and combined sewer and stormwater flows and convey these flows to the treatment plant. Due to bottlenecks from aging and out of service equipment and hydraulic capacity limitations, existing wastewater treatment plant facilities could not accommodate the volume of wastewater it received, so over 60 percent was diverted to lagoons after primary treatment. Discharge from the lagoons did not meet effluent standards, thereby polluting the Rapid Cris River.

The infrastructure failures identified by USAID included:

- Primary effluent pumps did not have the capacity to pump effluent to recently constructed aeration tanks

Figure 4-3. The Danube/GEF project refurbished digesters at the Oradea WWTP

Figure 4-4. Oradea WWTP Primary Sludge Pump

- Wastewater pumped into the primary distribution box frequently would overflow due to an incorrect sizing of the box
- Only one of four secondary clarifiers was functioning
- The facility had an ineffective return activated sludge system

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- None of the plant's digesters were in service because of the inoperable transfer pump, heat exchange, and mixing systems.

These infrastructure limitations resulted in secondary (biological) treatment being provided for less than 40 percent of the plant's influent flow. This bypassing of an essential step in the treatment process results in discharge of effluent high in BOD, ammonia, phenols, and suspended solids and persistent non-compliance with the Romanian water quality standards.

In addition to water quality impacts, groundwater impacts were occurring due to seepage from the lagoons and land application of undigested sludge. Because of the inoperative digesters the plant did not receive the benefits of the 40 to 60% volatile solids destruction which anaerobic digesters can typically provide, resulting in greater amounts of poorly stabilized sludge being applied to sludge drying beds.

Goals

The overall project objective at the Oradea wastewater treatment plant was to eliminate the discharge of inadequately treated wastewater to the Rapid Cris River and thereby decrease the risk of pathogens and other pollutants reaching the food chain downstream in Romania and Hungary.

Project Activities

The Oradea wastewater treatment plant is owned and operated by a Romanian government agency called R.A. Apaterm. As funds became available, R.A. Apaterm had been making improvements to the plant before the GEF/Danube project improvements took place.

Working together with R.A. Apaterm, The GEF/Danube project made key improvements to facilitate reliable treatment of all of the plant's influent wastewater. The plant improvements were designed for a 24-hour design flow of 2,200 liters/second (L/s), and the peak-hour design flow is 4,000L/s.

The improvements included:

- Addition of a new primary effluent pumping station with a capacity of 4000 L/s and reconstruction of the existing distribution box to prevent overflows.
- Rehabilitation of two return activated sludge (RAS) and waste activated sludge pumps. Included were new pumps, an electrical system, ventilation systems, and repairs to the building.
- Rehabilitation of two primary sludge pump stations. Included were new pumps, electrical systems, ventilation systems, and repairs to the buildings.
- New equipment for two sludge digesters, consisting of three pumps and grinders, two heat exchangers, two digester mixers, and repairs to the existing structures.

Figure 4-5. New Aeration Basin with Automatic Dissolved Oxygen Control

The primary effluent pumping station improvement was separately funded and constructed by R.A. Apaterm. This work was completed in November 1999 for a construction cost of $ 587,800.

IFOR SA, of Oradea, did the construction of the joint USAID/R.A. Apaterm funded improvements. When the improvements are completed, the plant will have a capacity of 2200 L/s. The construction costs was $1,215,352, of which USAID financed $858,303 and Apaterm financed $357,049. Considering the overall improvement program, R.A. Apaterm funded $944,849 or 52% of the total investment.

Results

Improvements to the Oradea WWTP achieved their objective of reducing pollution of the Rapid Cris River. Together with other improvements undertaken by the plant owners, these improvements

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will enable the plant to provide full secondary treatment and improve the reliability of the plant's performance.

The present average daily flow reaching the plant is 1800 L/s to 2200 L/s. When completed, the new plant facilities will eliminate the need for flows to be normally bypassed to the lagoons.

All of the plant's effluent will receive the higher quality level of secondary treatment plus ammonia removal. Projected effluent quality for the new plant is compared to pre-improvement effluent quality in Figure 4-6. The new plant will have to be capable of producing an effluent of 15 mg/L BOD, 45 mg/L COD, 25 mg/L TSS, and 10 mg/L ammonia, in accordance with the Romanian water quality standards. In addition, the plant will dramatically lower effluent ammonia levels and reduce phenols levels to below water quality standards. Reduced loads into the river will be about 56% less BOD, 56% less TSS, 89% less ammonia and 96% less phenols.

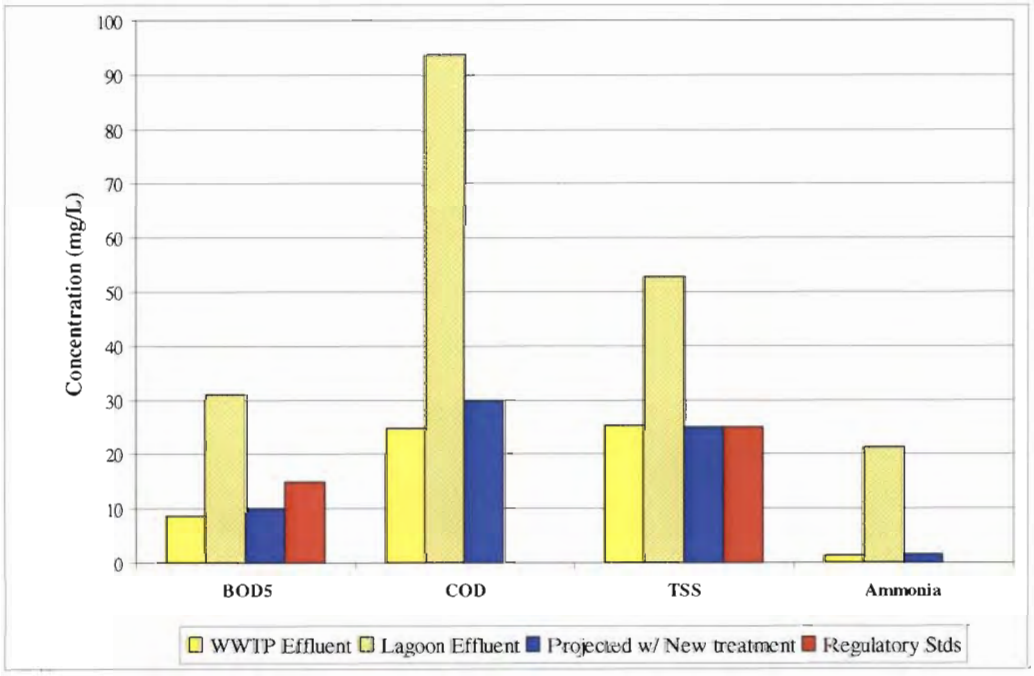

Figure 4-6. Effluent Quality Improvements at the Oradea WWTP

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4.3 INDUSTRIAL POLLUTION CONTROL

4.3.1 Overview of Industrial Activities

Background

In the early 1990's, USAID project design team identified seven industries in Bihor County, Romania as significant sources of transboundary pollution. These industries included: Petrom and Petrolsub, an oil production facility and a refinery in Suplacu de Barcau; three industries in the Oradea area, Pigmenti (an inorganic pigment manufacturer), Chimprod, (a pharmaceutical company) and UAMT (a metal finisher); and two mines in the vicinity of Stei, one a uranium mine and the other a non ferrous metals mine (copper, zinc, lead and molybdenum). When the GEF/Danube Transboundary Pollution reduction project work was awarded in 1995, pollution reduction at these seven Romanian industries was a substantial component of the overall program. Table 4-2 outlines the pollutants and issues at these industries.

M&E and USAID worked with a French engineering consultant (BCEOM) and with a local subcontractor (ECOIND, formerly ICPEAR) to promote cleaner production techniques and reduce industrial pollution.

Goal

The intent of the industrial pollution and waste control component of the project was to reduce pollution of the river from industrial wastewater and mining operations. Improving environmental management at these facilities was also intended to result in the generation of less waste and in lower energy consumption.

Project Activities

Working with each industry, project staff and subcontractors identified the most efficient, cost-effective improvements these seven industries could make to reduce industrial pollution and waste. The team then worked with the industries to find funding for the improvements. All work was performed under the general framework established in a letter of understanding (LOU) between USAID and the Romanian Ministry of Water, Forest, and Environmental Protection.

The principal steps in implementing the industrial program included initial environmental assessments, initial stakeholder agreements, final stakeholder agreements, contract bidding, contract negotiation, and construction.

Initial Assessments. Initial environmental studies (pre-assessment) were made by the M&E/BCEOM/ECOIND project team in the summer of 1997. One or two day site visits were made to each industry and this formed the basis of a detailed assessment report that was prepared in October 1997 with an update in March 1998. Work began in earnest for the Romanian industrial tasks after the November 1997 signing of the LOU. A second program of site visits to each industry occurred during the summer and fall of 1998, followed by a cleaner production workshop. Conceptual engineering reports were prepared for each of the seven industries. Each report included the findings of the on-site investigations and a prioritized list of recommendations.

Initial Stakeholder Agreements. In July 1999, representatives of Metcalf & Eddy, USAID, and the Romanian Industries met to agree upon priority investments, cost sharing, and the best means of implementation. Priority actions were identified by the Industries and by the GEF/Danube Project. Based on this initial agreement, the M&E team prepared scope of works for implementing the agreed upon actions at each industry using a design build approach to final design and construction. (Investments at one of the seven industries, a uranium mine, was cancelled due to the pending closure of the mine and very low potential for transboundary pollutions impacts)

Final Stakeholder Agreements. In early November 1999, M&E and each of the six industries met to formally sign the agreement on cost sharing and approach to project implementation. The agreement on cost sharing included a budget ceiling and an agreed upon percent of the total cost to be borne by each party. In general, the M&E (USAID) share is approximately 60% of the total. Each Industry also agreed to have their share of the work implemented by a single general contractor selected through a competitive bidding process.

TABLE 4-4. WATER QUALITY ISSUES AT SELECTED INDUSTRIAL FACILITIES IN ROMANIA

Facility	Pollutant(s)	Receiving Water Body	Environmental Issues/Comments
Petrom	Petroleum products	• Barcau River	• Products 1,400 tons per day of heavy crude oil • Phenols generated by extraction process • Exceeded permitted levels of pherols in wastewater discharge • No spill containment or runoff prevention around 140 injection wells and/or 660 production wells (40 wells closed per year) • Process wastewater discharged to municipal sewer
Petrolsub	Phenols, suspended solids BOD5 Petroleum products	• Barcau River	• Processes over 400,000 tons of crude oil annually • Phenols enter refinery with crude oil received from Petrom
Pigmenti	Zinc Chromium	• Rapid Cris River	• Production of Milori blue, chromium yellow, and chromium green pigments • Operating at 10-30% design capacity • Treatment plant receives wastewater high in zinc and phenols from other upstream industries
Chimprod	Phenols	• City Sewer	• Only salicylic plant in Romania exports more than 150 tons per month of salicylic acid product • Total production is exceeding design capacity • Industrial process wastewater is approximately 80 percent by volume of the total wastewater discharged from Chimprod • Using volumetric method to determine wastewater discharge
UAMT	Heavy metals	• City Sewer	• Operating at full capacity and plans to increase capacity by 15 percent within 2 years • In situ treatment of neutralizing and rinse water • Inadequate laboratory monitoring of acidity/alkalinity, cyanide, hexavalent chromium
Uranium mining	Radioactive substances	• Black Cris	• Soil samples exhibit radioactivity • Runoff from solid waste deposits is transported to river • Wastewater effluent does not meet Romanian standards
SM Baita	Copper, zinc, cyanide, and hexavalent chromium	• Black Cris	• Produces approximately 50,000 metric tons of ore per year • Total capacity of 250 tons/day • 8 tons of cyanide used for 40,000 tons/year of zinc-containing ore processed

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Contract Bidding. M&E issued a Bid Document to four general contractors in January 2000. The scope of the Design-Build Contract covered all the Industrial wastewater treatment and cleaner production improvements at each of the six industries. A fixed price proposal was requested for the total design, equipment procurement, construction, start-up and testing of all of the proposed improvements. Detailed cost estimates (schedule of values) were required as part of the bidding process to allow the work to be subdivided later between industry and M&E (USAID) funded portions of the work. After receipt of a "Best and Final" offers, M&E selected Envirotech S.A to design and construct the industrial pollution control improvements.

Contract Negotiation. M&E awarded a contract to Envirotech in March 2000 for specific portions of the work at each Industry. Each industry also entered into a separate contract with Envirotech for the remainder of the work at each facility. Using the financial breakdown in the bids, M&E negotiated with the stakeholders and subdivided the general contractor's work into industry funded and M&E (USAID) funded contract packages. M&E's goal in subdividing the work between M&E (USAID) and the industries is to preserve the financial allocations established in the Agreements and to preserve as much sub-project independence as possible. Although work will be implemented by the same general contractor, work will be paid for by multiple contracts, one by M&E and one by each Industry. This allowed the USAID work and the other work at each industry to be coordinated, but not be dependent on each other.

Construction. Design and construction activities began in April 2000 and extended into the fall. Startup and testing began in September and were mostly completed that fall within the allocated budget.

In addition to the pollution - reducing improvements that were financed by the project at each of the industries, special attention was also paid to improving cleaner production, environmental management, and self-monitoring capabilities:

Cleaner Production Training. Recognizing the fundamental importance of waste minimization and advantages of cleaner production in an increasingly global economy, the project sponsored a two-day training session in September 1998. The session was hosted at the Oradea Chamber of Commerce and participants included 20 attendees from Oradea industries and regulatory agencies. The workshop focused on cleaner production techniques and technologies, the development of corporate environmental management systems, and the principles of ISO 14000 standards. Participants gained a clearer understanding of cleaner production concepts and implementation, and the workshop also served to improve cooperation between inspectors and industrial environmental specialists.

Environmental Management Plan Training. The project sponsored another workshop in September 1999, attended by representatives from the six industries. The workshop addressed how to develop and implement environmental management systems. The purpose of developing these systems was to help the companies gain greater control over the environmental impacts of their activities, products and services, particularly the impacts on water. This training was conducted as a first step for the industries towards compliance with the requirements of ISO 14000.

Self-Monitoring Improvements. An adequate laboratory capability for routine monitoring of key pollutants is an essential ingredient in minimizing pollution discharges. As part of the needs assessment at each industry, the highest priority laboratory analytical equipment was also identified. As part of the cost sharing agreement for project implementation, a total of $80,000 was spent by industry for laboratory equipment upgrades.

4.3.2 PETROM

Background

Located 75 km northeast of Oradea, Petrom's main activity at the Suplacu de Barcau facility is petroleum production. Approximately 1250 t/day of asphalt-base petroleum is extracted from underground oil fields through underground combustion and cyclic steam injection. The extracted crude contains 55% water and other impurities and is refined into an asphalt crude with less than 1% impurities by thermochemical processing. There are three main steps in the petroleum extraction-separation process: extraction, separation, and crude petroleum purification. The

main wastewater sources include the oil rigs, separation tanks, crude petroleum demulsifying/ separation, compressors, and steam condensation. The plant has 1400 workers.

Existing wastewater treatment facilities include physical-chemical treatment facilities in two locations:

- Demulsification/Oil Separation. The high water content in the crude oil is reduced by freeing emulsified oil and then separating the oil water mixture by gravity. Polymers are added to the crude oil/water mixture to assist in the separation. Recovered oil is sent on for further purification and the separated water routed for additional wastewater treatment.

- General wastewater treatment. Wastewater from the separation process and other sources receive equalization, free oil separation, coagulation and flocculation for emulsified oil removal, clarification, and sand filtration. Treated effluent is discharged to the Barcau river.

Goals

The objective of USAID involvement at Suplacu Petrom was to reduce the contamination of the Barcau River from petroleum products and phenols, both of which were released through point discharges and through nonpoint surface runoff over land contaminated by spills and leaks.

Project Activities

The project procured equipment to improve the extraction-separation and wastewater treatment processes and installed concrete aprons around wellheads to control runoff.

Wastewater treatment improvements focused on the demulsifying and coagulation-flocculation processes, to increase the efficiency of oil removal from the wastewater. For demulsification, a new automated polymer makeup and feed system was added. The addition of the chemical, which is essential for removing oil from the oily water fraction, will be paced by new flow meters to meet the varying flowrates in the oil production process.

For the coagulation/flocculation process, new equipment included flow measurement, alum feed pumps, and a polymer makeup and feed system maintain the appropriate dosing of cationic polyelectrolyte solution and aluminum sulfate to catalyze the demulsifying and flocculation processes. These were intended to increase removal efficiency of petroleum products, formerly 60 - 80 percent, to 98 percent.

In separate action funded entirely by Petrom, additional concrete aprons with curbs were constructed around new wellheads to minimize the conveyance of spilled oil, via surface runoff, to the river. Petrom had previously installed spill collection pads at 75 of their 300 oil production wells and had agreed to install another 75 as part of their contribution to the project.

Results

Tests were run in October 2000 to compare the old technology with the new technology.

Figure 4-7 shows the improvements to the oil-water separation in demulsification. Residual oil product in the range of 60 to 70 Mg/L before the treatment modifications was reduced to less than 20 Mg/L, an average reduction of more than 70 percent.

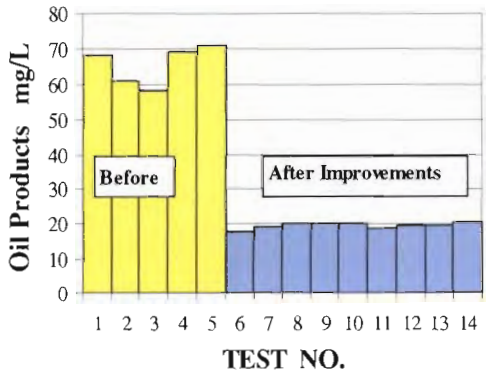

Figure 4-7: Oil Product Recovery at the Demulsification Step at Petrom

Figures 4-8 and 4-9 show the improvements to the flocculation process at the main wastewater treatment plant. More than a 90% reduction in oil product content and 68% reductions in total suspended solids (TSS) were achieved when compared to the pre-improvement conditions.

The new equipment and training achieved sustainable pollution reduction at this plant. In

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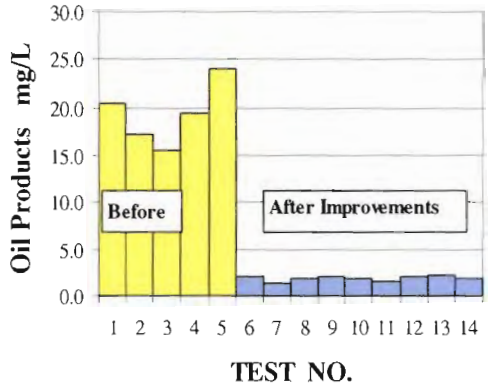

Figure 4-8. Oil Reduction from Flocculation Improvements at Petrom

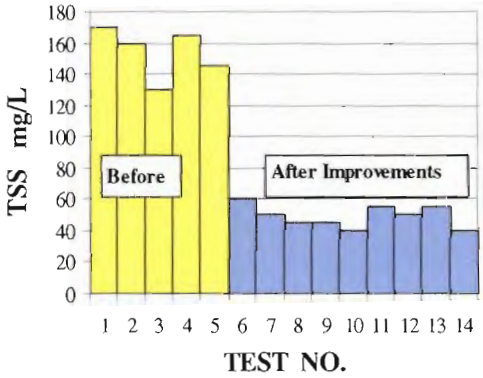

Figure 4-9. Suspended Solids Reduction from Flocculation Improvements at Petrom

addition, ecological awareness was increased among industry staff. The total cost of the project was $134,786, of which USAID financed $110,140 and PETROM provided $24,646. In addition to sharing in the costs of the treatment improvements, Petrom also committed to $10,000 of additional spending for essential laboratory equipment.

4.3.3 PETROLSUB

Background

The final product from the Petrom oil extraction unit, which includes petroleum with less than one percent water, is transported from Petrom to the Petrolsub refinery. The refinery has a processing capacity of 400,000 tons of petroleum per year. The refinery produces oils and fuels by distillation and asphalt oxidation. Wastewater from these processes is conveyed to the wastewater treatment plant.

The main treatment steps at the **Petrolsub wastewater treatment plant** are equalization, oil-water separation, coagulation-flocculation (lime milk + aluminum sulfate), dissolved air flotation, and biological treatment. Wastewater from the treatment facility is discharged to the Barcau River. The treatment system has a design capacity of 60 m^3/hour.

Before the project began, the wastewater treatment plant operated with only manual addition of the chemicals used to release emulsified oil during the treatment process. Also, the biological treatment step was not fully functional due to the inoperable aeration and sludge return equipment. As a result, the biological treatment basins were used as a supplementary settling step, rather than for the intended biological treatment.

Project Activities

At Petrolsub the project made improvements to the physical/chemical process and renovated the biological process at the wastewater treatment plant. The equipment installed included a tank and vacuum pump for the preparation of the lime milk suspension and storage tanks, meter pump, and pH meter for the storage and appropriate dosing of the The renovation of the biological treatment process required new equipment for the aeration system, nutrient preparation-dosage equipment, and sludge recycling pumps. The equipment provided included two air blowers to supply air to the existing activated sludge basins, dissolved oxygen meter, nutrient preparation vessel, meter pump, transfer pump, and a flow meter. The new air blowers required the construction of a new building near the aeration tanks.

Results

Results of the investments in the Petrolsub physical chemical treatment improvements are shown in Figures 4-10, 4-11, 4-12, and 4-13, BOD_5, COD, and TSS. Depending on the parameter, a 67 to 80 percent reduction in pollutant levels were achieved when compared with the pre-investment condition. Similarly positive results are expected once the renovated biological treatment step begins operation in the Spring of 2001. The investments at Petrolsub were relatively evenly divided between local and USAID funding. The total investment in WWTP improvements was $346,129 of which USAID

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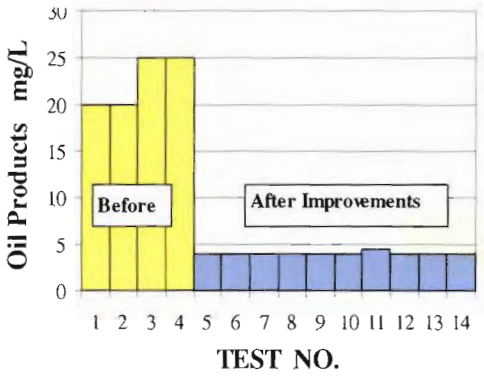

Figure 4-10. Oil Product Reduction at Petrolsub

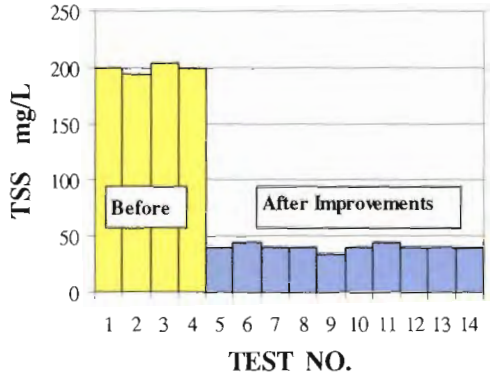

Figure 4-11. Suspended Solids Reduction at Petrolsub

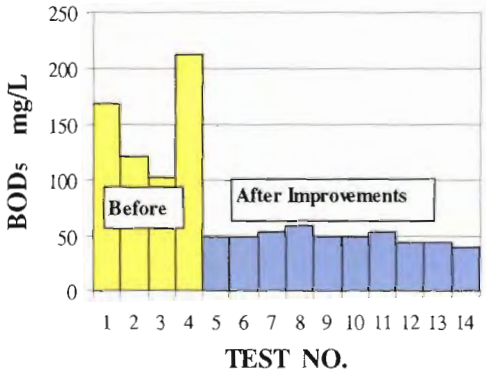

Figure 4-12. BOD_5 Reduction at Petrolsub

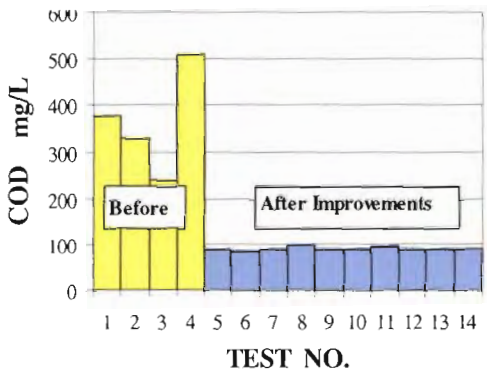

Figure 4-13. COD Improvements at Petrolsub

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contributed $161,733 and Petrolsub $184,396. Petrolsub also committed to $10,000 of additional spending for essential laboratory equipment.

4.3.4 PIGMENTI

Background

Pigmenti manufactures inorganic pigments, zinc-based materials, stabilizers and additives for plastics, coating products, and chemical products for domestic use. The 450 employees at Pigmenti manufacture 1,250 tons per year of inorganic pigment and stabilizer products. Formerly part of Sinteza Chemicals, Pigmenti was privatized in 1992 but is still located on Sinteza property and downstream of other production facilities operated by Sinteza. The Pigmenti wastewater plant receives wastewater high in contaminants from a number of sources in addition to the its own pigment production facility.

Current production is only 15 to 30% of the facility capacity. Thus the volume of wastewater produced at the Pigmenti operations is approximately 1000 m^3/day. The wastewater treatment plant was originally designed to process 150 m^3/hour, or 2,329 m^3/day of wastewater. Production is normally done over 12 hours per day, five days per week.

Existing wastewater treatment processes involve the reduction of hexavalent chromium to trivalent chromium with sodium sulfate at a low pH, the precipitation of metal hydroxides, and settling. The sludge generated during the treatment process is conveyed to a receiving basin and then to a liquids dump(USAID, 1999b). The wastewater, as well as neutralized supernatant from the liquids dump, is discharged to the Rapid Cris River. There is frequent non-compliance for chromium, zinc, and lead concentrations.

The old equipment in the wastewater treatment plant included a reagent preparation room, wastewater receiving basin, wastewater storage basin, pump station, reaction basin, neutralizing basin, vertical decanter, and sludge receiving basin. The equipment was antiquated and typically resulted in an inefficient reduction reaction for chromium due to an inability to regulate the pH during the reactions. The facility also demonstrated a low efficiency of metal hydroxide precipitation and subsequent separation of suspended solids. Finally, the facility lacked the ability to adequately control and monitor the effluent discharged to the Rapid Cris River.

Goal

The USAID objective at Pigmenti was to minimize the generation of chromium and zinc in production process and to maximize chromium and zinc removal from wastewater.

Project Activities

This project provided improvements at the chromium treatment process and metals precipitation system, such as automatic pH controls and new automatic reagent dosing equipment.

The project replaced the pH automatic control equipment with a dosing pump and a pH control system to control the automatic dosing of sulfuric acid to maintain a pH of 2.5-3 during the chromium (VI) reduction reaction(See Figure 4-14). The reaction requires a low pH in the wastewater to facilitate a complete reduction of chromium.

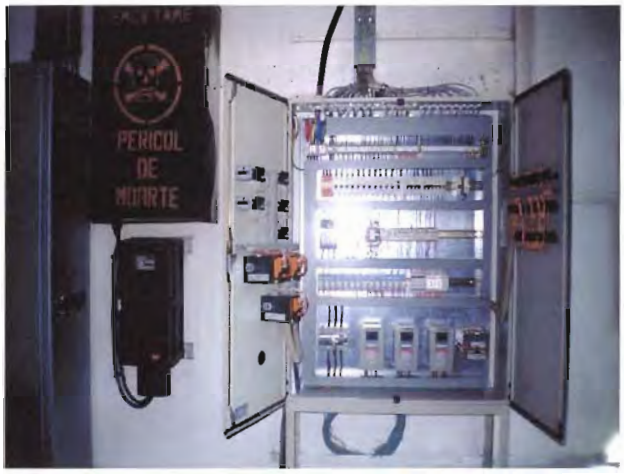

Figure 4-14. New Pigmenti Control Panels

Similar equipment was installed to automatically dose hydroxide solution so the wastewater pH is maintained at a level sufficient to precipitate metallic ions. New equipment also maintains the appropriate dosage of anionic polyelectrolye solution before the clarification step, to improve removal of suspended material and metals.

A total investment of $85,746 was made at Pigmenti. USAID provided $54,928 and Pigmenti contributed $30,828. Other Pigmenti contributions

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to the project was approximately $10,000 of additional WWTP laboratory equipment.

Results

Performance of the new wastewater treatment improvements was monitored after startup in September and October 2000. Results of the testing are summarized in Figures 4-15 and 4-16 for total metals (including chromium, lead, zinc and iron) and total suspended solids. These results demonstrate that an average reduction of 83% for suspended solids and a 95% for total metals when compared to the existing WWTP performance.

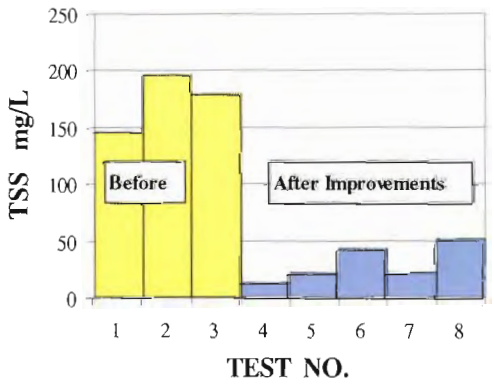

Figure 4-15. Total Suspended Solids Reduction from WWTP Improvements at Pigments

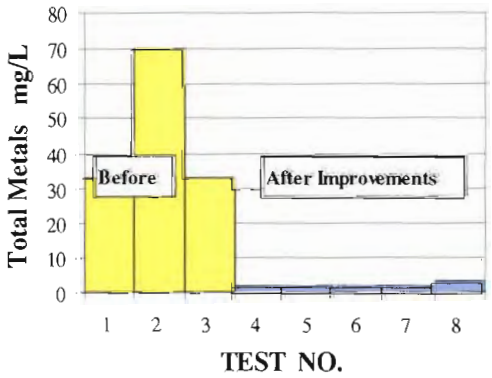

Figure 4-16. Effluent Metal Reduction from WWTP Improvements at Pigment

With the new chromium reduction improvements, hexavalent chromium levels in the Pigmenti wastewater discharge have been consistently below the limits of analytical laboratory detection.

4.3.5 Chimprod

Background

Like Pigmenti, Chimprod was originally a part of the Sinteza Chemical Enterprise and has been privatized. The pharmaceutical company produces mostly salicylic acid and derivative products (e.g. aspirin); however, it also produces smaller quantities of benzoic acid and sodium benzoate products, coating products, various chemical conditioning products, and organo-phosphorous pesticides. In 1997, the production of salicylic acid at Chimprod was approximately 1,967 tons/year. In 1998, the production decreased to 1,500 tons/year due to production inefficiency from failing equipment. The plant employs 280 employees. Production is normally done over 24 hours per day, seven days per week.

Before the project began, the salicylic acid production equipment included twelve autoclaves, system of condensers, seven plunger-type vacuum pumps, and centrifuge. About 90% of the wastewater and 75% of the phenols result from centrifugation. Significant inefficiency in production was discovered because of low vacuum levels. The seven vacuum pumps required frequent maintenance and no more than four were typically operating at one time, resulting in insufficient vacuum for the extraction and condensation steps of the batch production process. Higher levels of phenols ended up in plant's discharge due to poor extraction of unreacted phenol and incomplete separation of phenol and water in the condensing system.

Chimprod's existing wastewater treatment facilities consists of an old separator with manual oil collection, neutralization, and aerated equalization. Phenol is the principal pollutant discharged to the Oradea public sewerage system. Very high levels of phenols are allowed by permit (360 mg/l) as Chimprod predecessor Sinteza financed an expansion of the Oradea WWTP in 1981.

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Goal

The USAID objective at Chimprod was to increase efficiency of the plant, thereby minimizing both waste production and raw material consumption.

Project Activities

The project installed four new wet type vacuum pumps with a total capacity of 2,400 m^3/hr (See Figure 4-17). The old plunger pumps will be kept in reserve for emergency services. The new pumps will operate 24 hours/day all year except for one month during the summer for maintenance.

Figure 4-17. Chimprod Vacuum Pumping Station

Total investment in Chimprod waste minimization was $93,095. USAID contributed $58,167 and Chimprod $34,928. (Note: Chimprod also invested $10,000 in laboratory equipment).

Results

Phenol in the sewer discharge is monitored Monday through Friday. From January 1999 through August of 2000, just before vacuum pump startup, average phenol in the sewer discharge was 292 mg/L. In two months of operation during the fall of 2000 with the new vacuum pumps in service, average concentration of phenol in the discharge was 191 mg/L. Thus an average phenol reduction of 100 mg/L or 150 kg/day was provided through this cleaner production improvement.

4.3.6 UAMT

Background

UAMT is a private, joint stock metalworking company that manufactures a variety of products, mostly for automobiles. The present market is mostly national, but contacts have been made with major European car companies. There are 2,600 employees and the plant has been operating at 85-90% capacity. Electroplating of 250,000 square meters per year of metal parts creates most of the pollution problems with zinc, chromium and nickel exceeding permitting limits for discharges into the Oradea public sewerage system. UAMT has a wastewater treatment plant for heavy metals, cyanide, and hexavalent chromium and about 84% of treated wastewater is recycled into the metal plating rinsing process. UAMT has a Quality System and is preparing for ISO 9001 certification. Many operational procedures refer to environment, but there is no formal Environmental Management System (EMS), and ISO 14001 certification is not yet planned.

The metal plating section of the UAMT plant has two electroplating workshops, designated GI and GII, which include several metal plating processes (zinc, nickel, chromium, and copper plating). The project team noted several inefficiencies in water usage and automation of the process. Water usage was not optimized: cleaner water streams were used for both initial and final rinsing of parts, rather than a more efficient "cascade" flow pattern (e.g. rinsewater flows are first used for final rinses and cascade backwards for use in initial rinsing). The second inefficiency was in the automation of the process. The existing controller for automating the dipping of the metal parts in the various cleaning, plating, and rinsing baths in the plating line was outmoded and lacked modern capabilities for pollution prevention. For example, there was no ability to control the time intervals for part immersion and dripping after immersion to minimize dragout from the concentrated plating solutions.

Unit treatment processes at the existing wastewater treatment plant include equalization, chrome reduction, cyanide destruction and heavy metal precipitation and settling. Settled sludge is dewatered by a plate and frame filter. Wastewater

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sources are segregated for different types of treatment at the WWTP. Recycled wastewater containing chromium and zinc along with acidic wastewater were conveyed to the equalization tank, and then treated in batches in a neutralization tank where the pH is adjusted. Recycled wastewater containing cyanide and alkaline flows were also equalized in a separate tank and then conveyed to the same neutralization tank. In the neutralization tank, the combined flows were treated according to the wastewater composition. However, treatment was typically regulated based on pH. Chromium treatment and cyanide treatment require different pH levels to adequately catalyze each reactions completely. Therefore, the inefficiencies of the treatment plant were twofold: antiquated equipment and insufficient equipment. This resulted in a discharge of metals in excess of permitted thresholds and a high consumption of chemical reagents. In addition, sludge generated during the final filter press process was not properly stored or disposed of (USAID, 1999b).

Goal

The USAID objective at UAMT was for the facility to demonstrate for the ten other metal finishing operations in Oradea the benefits of pollution prevention and for UAMT to achieve compliance with established wastewater effluent discharge limitations.

Project Activities

The project procured and installed new chemical feed and storage equipment that is automatically controlled to assure treatment efficiency and minimize reagent consumption. Specific improvements included:

Chrome Reduction. New sulfuric acid and sodium bisulfite feed systems were provided for chemical reduction of hexavalent chromium to the less toxic trivalent chromium. New pH and ORP controllers were provided to modulate the chemical feedrates.

Cyanide Destruction. New sodium hydroxide and sodium hypochlorite feed systems were provided for chemical oxidation and destruction of cyanide at a high pH. New pH and ORP controllers were provided to modulate the chemical feedrates (See Figure 4-18).

Final Neutralization. After the chrome and cyanide pretreatment, wastewater is neutralized to promote precipitation of heavy metals. Neutralized wastewater is filtered by the existing filter press and reused or discharge to the Oradea sewer system. A new pH meter was provided by the project for monitoring the final neutralization process.

Figure 4-18. Cyanide Destruction System, UAMT

The project also invested in two cleaner production initiatives:

Cascade Rinsing. Four new rinsing tanks were added to an existing Cu-Ni-Cr line along with two automatic recycle pumps. Another cascade rinse tank was added on the Zinc 1 plating line. Flow meters were also provided to allow direct monitoring of water usage.

Process Automation. Two plating lines, Zinc 1 and the Cu-Ni-Cr line were selected for the supply of a new central processing unit. This included supply of a programmable robot, field sensors, and all required software.

Total investment in the UAMT improvements implemented through the Envirotech contract was $95,011. USAID contributed $84,696 and UAMT $10,315. UAMT made an additional contribution by separately funding the process automation improvements (approximately $20,000).

Results

The new waste minimization and wastewater treatment improvements were tested during a 14 day

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period in October 2000. Conclusions of the testing were that:

A 50% reduction in water usage was achieved by cascade rinsing. Associated savings in plating chemicals will save more then $20,000 per year and reduce losses nickel and copper by more than a metric ton per year.

Testing of the improved wastewater treatment plant demonstrated consistent hexavalent chromium and cyanide levels that were below detection in the treated effluent.

UAMT also completed the planned process automation improvements. It is expected that this improvement, together with the cascade rinsing, will result in a 30% reduction in heavy metal discharges from the modified plating lines.

4.3.7 Uranium Mining

Romania does not have standards for wastewater discharges of uranium (U) and radium (Ra), so Romanian regulatory authorities had been using Romanian drinking water standards (0.021 mg/l U and 0.088 Bq/l Ra) for the Uranium mining operations (Exploaterea Miniere Avram Iancu). These standards are much more stringent than standards applied to similar receiving waters in Western Europe, which are 1.8mg/l U and 0.38 Bq/l Ra where dilution is greater than 5 to 1.

Monitoring data collected by M&E subcontractor BCEOM showed very low concentrations of uranium (U) and radium (Ra) for all discharges associated with the mine. These concentrations are consistently below even the drinking water standards. The area around the site is uninhabited, and the mine is expected to be closed in about ten years.

For these reasons, the GEF/Danube project took no actions at the site, choosing to spend resources where they would do more good. The project did recommend that the mining company and the Central Environmental Protection Authority (ACPM) consider modifying the environmental permit for the mine, based on more appropriate environmental standards. Uranium mining operations are located adjacent to the Baita River, a tributary to the Black Cris River.

4.3.6 SM Baita (Nonferrous Metals Mining)

Background

The SM Baita non-ferrous mining industry is located along the Baita River, a tributary to the Black Cris River, near the city of Stei. The small-scale sub-level mine produces approximately 50,000 metric tons of ore per year (USAID, 1999c). The mining operation was identified as contributor of pollution to the Baita River. Cyanide, used during the processing of the ore, and copper levels frequently exceeded established discharge limits. Hexavalent chromium and zinc occasionally exceeded permissible thresholds. Wastewater from the mining operations (approximately 3500 cubic meters/day) was pretreated with calcium hydroxide and hypochlorite prior to conveyance through a 6.5 km pipeline to the tailings pond located adjacent to the river. There is no monitoring of treatment process to modulate chemical feed rates and maintain treatment efficiency. Supernatant from the tailings pond overflowed into a discharge pipe and entered the river. The remaining liquid in the pond seeped through the soils and into the freshwater aquifer located below the pond. The tailings pond contains more then 4 million metric tons of tailings (i.e. waste rock). Because the method of the ponds construction, fluctuations in the groundwater table and erosion of the sideslopes over time could lead to structural instability and potential failure of the tailings pond dike.

Goal

The USAID goal was to reduce the discharge of cyanide into the Black Cris from the nonferrous metals mining industry and institute operational changes to protect the integrity of the tailings pond dikes.

Project Activities

The project procured and installed equipment to neutralize cyanide by the addition of lime milk and hypochlorite and provide for the automatic regulation of the neutralization process. The new facilities are targeted only for cyanide bearing flows from the flotation process and have a design flow of 300 cubic meters/day (See Figure 4-19). The equipment included two tanks to house the reactions

Figure 4-19. Baita Cyanide Destruction System

and pumps to dose the appropriate reagent into the tanks.

Monitoring wells were installed around the existing tailings pond to monitor the fluctuation of groundwater levels, which may undermine the stability of the dike.

Total investment in the mining improvements implemented through the Envirotech contract was $117,354. USAID contributed $79,074 and the mine $38,280. The mining company made an additional contribution by separately funding the tailings pond monitoring wells and purchase of a water quality related laboratory equipment (approximately $50,000).

Results

Performance testing of the new system was accomplished in November 2000. During fourteen days of consecutive testing, 123 mg/L of average influent cyanide from the flotation tanks was routinely reduced to below analytical detection (0.02 mg/L).

[*More information to be inserted in final report on old CN discharges*]

Further reduction in heavy metal discharges can be expected from the improved process control provided by an enhanced on-site laboratory capability. Lowering of environmental risk from the tailings ponds is provided through new plant environmental management system sponsored by the project and commitment from the mining company to regularly monitor groundwater levels and tailing pond slope stability.

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Section Five

Section Five
GEF/DANUBE ACHIEVEMENTS

The overall achievements of the GEF/Danube project included significant improvements in infrastructure and building sustainability by promoting institutional and cultural changes. These overall results are briefly summarized with additional information provided on project funding and the reductions in transboundary pollution that were actually achieved. Finally, lessons learned from the project are described to provide a basis for better implementation of future projects.

5.1 RESULTS

Infrastructure Improvements

- Four monitoring stations constructed; four more designed
- Secondary treatment completed and partial nutrient removal achieved at two of the largest wastewater treatment plants in the region
- Laboratory equipment installed on both sides of the Hungary/Romania border
- Industrial pollution control and cleaner production improvements put in place

Institutional and Cultural Changes

- Environmental inspector training: 25 attendees in Bihor County, Romania
- Preparation of an aquifer protection plan for the transboundary Maros aquifer, including development of an international county-to-county agreement
- Environmental laboratory training: 28 participants in Bihor County, Romania
- Emergency planning workshop: 80 trainees from six countries
- Cleaner production workshop: 22 trainees from Bihor County industries and regulatory agencies
- Environmental management training as a first step towards ISO 14000 compliance: 15 trainees from Bihor County industries
- Industrial environmental management plans implemented at six Romanian industries
- Transfer of U.S.-based environmental engineering practices to local consulting firms
- Local commitment demonstrated by providing 100 percent matching funds for key infrastructure improvements

5.2 POLLUTION REDUCED

The annual average reduction in transboundary pollution is approximately 8800 metric tons. Figure 5-1 presents a breakdown of this pollution reduction achievement by source, and Figure 5-2 presents a breakdown by type of pollutant. These reductions illustrate the key investments of the project in municipal wastewater treatment and consequent major reductions in organic loading

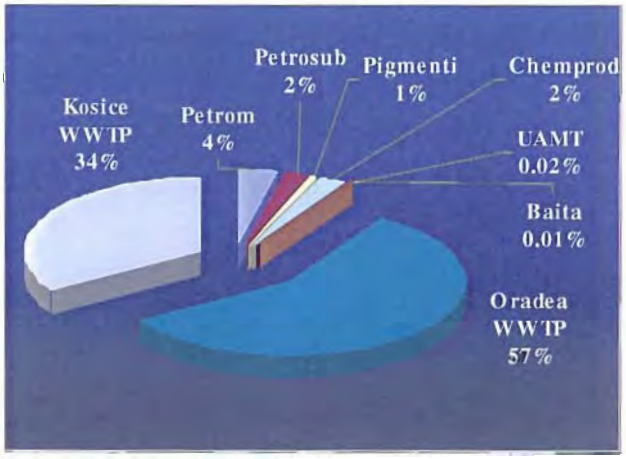

Figure 5-1. Pollution Reduction by Source

(COD and BOD_5) and nutrients. This improvement will result in long-term improvement to downstream water quality by lowering the potential for low dissolved oxygen and eutrophication.

Note that this simplified analysis adds the sum of all pollutants equally without consideration of their

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differing environmental impacts. For example, the project achieved relatively modest reductions in the tonnage of cyanides and heavy metals. However, considering that the toxicity of these compounds is orders of magnitude higher than for the toxicity of conventional pollutants, these reductions achieved are quite significant in terms of water quality.

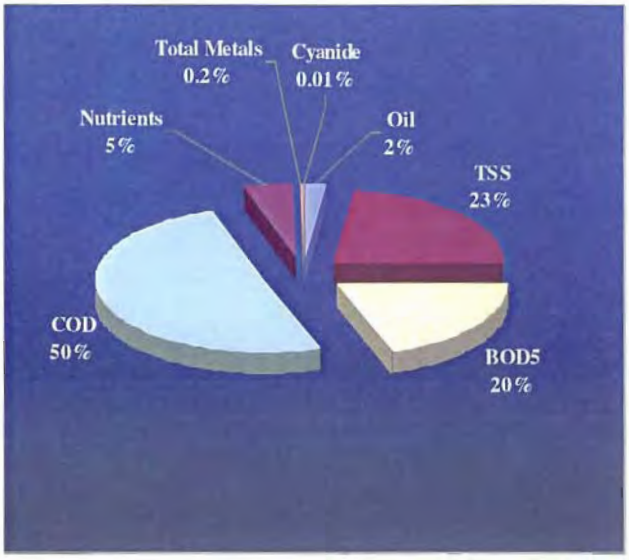

Figure 5-2 Annual Pollution Reduction by Type of Pollutant

5.3 PROJECT FUNDING

The total funding for the project included $6.4 million from USAID and $2.8 million from local sources for a combined project budget of $9.2 million. Figure 5-3 presents this overall budget. Approximately two thirds of funding was allocated to equipment procurement and infrastructure improvements. The remaining third provided conceptual, preliminary, and final design; training and other technical assistance; and project management.

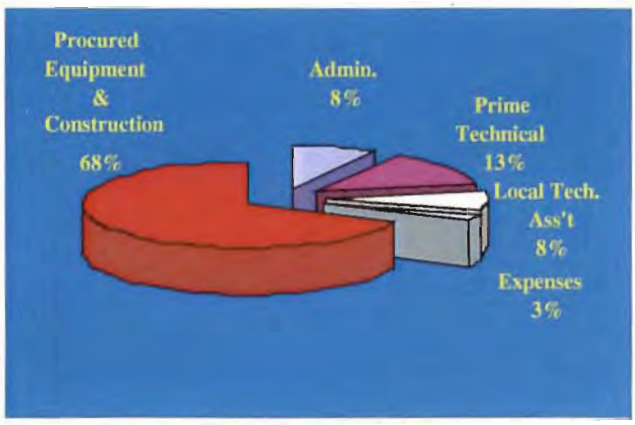

Figure 5-3. Overall Project Budget

It should be noted that local funding includes only $125,000 of national government funds. All the rest of the $2.8 million was raised through loans and in-kind arrangements at the local level.

Figure 5-4 presents a breakdown of the $6.3 million capital budget. The major recipients of this funding were the two municipal wastewater treatment plants. Other key investments included industrial pollution control, industrial cleaner production, online water quality monitoring stations, and laboratory assistance. The laboratory investments include both laboratory equipment for government agencies in Hungary and Romania and technical assistance for improving self-monitoring capabilities at the Romanian industries.

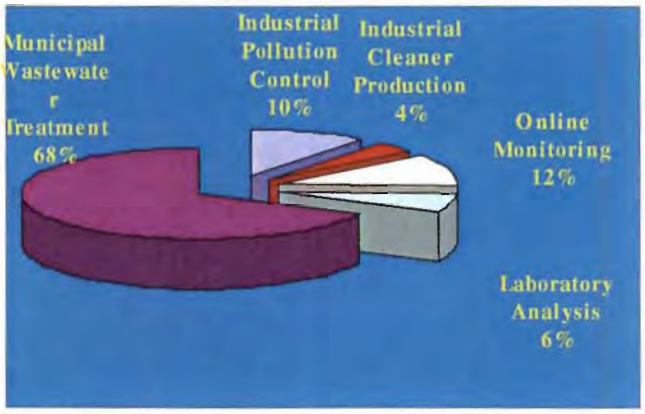

Figure 5-4. Breakdown of Combined Capital Budget

Figure 5-5 summarizes the $3.5 million of USAID investment by donor. The average investment was approximately $100,000 and the largest approximately $1.2 million.

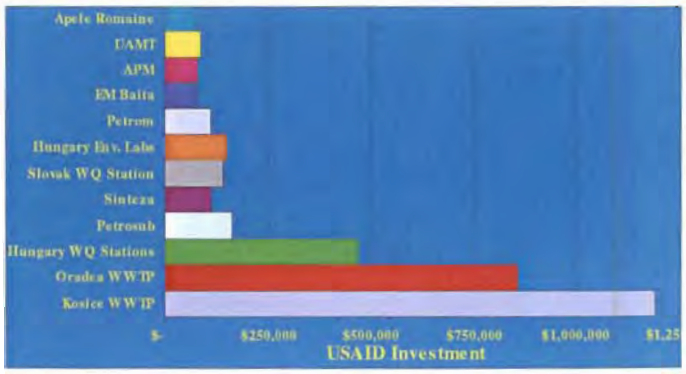

Figure 5-5. Breakdown of USAID Spending by Recipient

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5.4 LESSONS LEARNED

The GEF/Danube project was complex and challenging, and the lessons learned from this project may be useful in guiding the development and implementation of other USAID projects in the Newly Independent States.

Lesson #1: Letters of understanding can be effective if followed by rapid project implementation.

LOU agreements with the host countries were negotiated concurrently by USAID at the beginning of the project. These agreements were complicated by an absence of bilateral agreements at the start of the project. Experience from the GEF/Danube project clearly indicates that long delays from extended LOU negotiations allow too much time for changes to occur at the local level. The end result is shifting local needs and even further delays caused by the need to redirect, reevaluate, and revise project activities.

At the Kosice wastewater treatment plant, for example, by the time the project team made its initial surveys, the plant's owner had already implemented the improvements that formed the core of the planned project activities in Slovakia. A second example lies in Hungary, where the signatory of the LOU, the Ministry of the Environment, cancelled its participation in four of the seven water quality monitoring stations because of changing financial conditions.

Lesson # 2: Keep approaches flexible and the USAID financial commitments undefined.

The detailed financial commitments from USAID in each of the LOUs were no secret at the local level. Every industry we visited in Romania, for example, appeared to be very familiar with the investment dollars targeted for its facility. Thus, to avoid the risk of not meeting local expectations, investment targets should be set in only the most general of terms, with dollar values provided at only a program or national level. Investment targets should also be accompanied by a clear outline of investment criteria, with the inference clear that the dollars will be spent only where the most good will be obtained.

With this approach, initial survey work can more freely rank potential investments, and decisions on the recommended project investments can be made without the constraints of changing prior commitments. An example of this is the more than $400,000 that was targeted in the LOU for the Romanian uranium mine. The actual investment, after several years of visits, detailed assessment studies, and a conceptual engineering report was zero because of the relatively low environmental risk, consequently low environmental benefits, and likelihood that the mine would close in the near future. A less awkward approach would have been to avoid mentioning these upfront dollar commitments.

Another reason for maintaining a flexible approach is that cultural, institutional, technical, financial, and contractual constraints can vary widely, and the project needs the flexibility to choose the most effective means and methods of implementation for a particular activity.

Lesson # 3: Cost sharing is an effective tool and is best implemented at the local level.

Cost-sharing was complicated by changed circumstances, but it turned out to be an effective way to reduce costs and build commitment in the countries and industrial recipients of USAID assistance. When the LOUs in each country were negotiated, commitments on shared funding were agreed upon with each country's environmental ministry. As this agreement was not ratified by the Ministry of Finance in each country, with few exceptions, funds were not budgeted for the GEF/Danube project at the national level. Thus, the M&E team was forced to renegotiate and obtain funding commitments at the local level. This was ultimately successful, as illustrated in Figure 5-6, as more than $2.7 million in local contributions were provided.

Lesson # 4: Local funds can be brought in by having multiple contracts with a single general contractor.

Another weakness of the LOUs was their silence on how local funds were to be brought in to the project. U.S. procurement standards, including the FAR regulations, created further obstacles to local cost sharing. A second concern was that cost-sharing agreements were negotiated based on budgetary costs, with the assumption that each party would contribute a fixed percentage of the total.

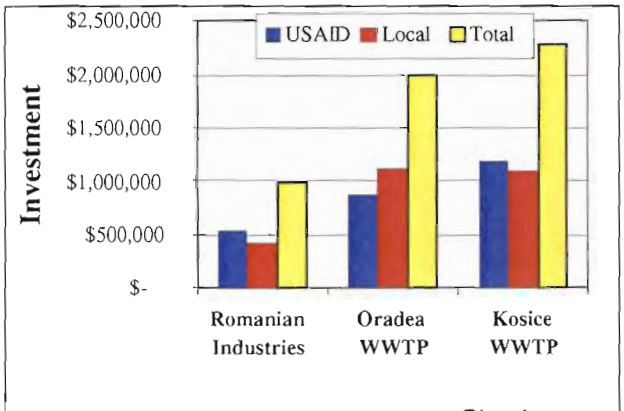

Figure 5-6. Summary of Major Cost Sharing

The M&E team solved these procurement related problems by taking bids on a combined procurement package and splitting up the work later into separate USAID-funded and locally funded contracts that closely approximated the percentages in the cost-sharing agreements. This approach was successful for both the Oradea wastewater treatment plant and the industrial work in Romania.

Lesson #5: A design-build approach saves time and money.

With the relatively small size of the typical GEF/Danube investment (about $100,000), use of a design-build project approach was well suited to the modest size of local engineering and construction firms. By matching the investment size to the capabilities of local firms, the project achieved significant savings in implementation time (e.g., approximately 12 months for the industrial work in Romania).

A second benefit of the design-build approach was in accelerating the design process and more quickly obtaining the input of specialized equipment vendors. Because of the limited depth of local engineering firms, detailed design expertise often resided in equipment vendors. Early involvement of these vendors as part of the successful bidders' team contributed to the almost zero dollars in change orders observed for the Romanian industrial work and the Slovak and Hungarian water quality monitoring stations.

Lesson #6: Allow Extra time for contract negotiation.

Delays in executing contracts with local engineering or construction subcontractors were caused by a number of factors, including general unfamiliarity with American business practices, the burden and inaccuracies of translation, and the often complicated flowdowns from USAID's contract with M&E. Other problems included repeat negotiation for insurance and bonding provisions as a result of variations in availability from country to country. The best advice for future projects to minimize delays is to simplify contracts as much as possible, beginning with the USAID prime contract.

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Section Six

BIBLIOGRAPHY

Bibliography will be provided in the final version of this report.